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Missouri River Basin final environmental impact statement for water reservation applications above

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FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR WATER RESERVATION APPLICATIONS ABOVE FORT PECK DAM

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ABBREVIATIONS

af — acre-feet
af/y — acre-feet per year
ARM — Administrative Rules of Montana
BHES — Montana Board of Health and Environmental Sciences
BLM — United States Bureau of Land Management
Board — Montana Board of Natural Resources and Conservation
BOD — biological oxygen demand
BUREC — United States Bureau of Reclamation
cfs — cubic feet per second
cm — centimeter
COD — chemical oxygen demand
Corps — United States Army Corps of Engineers
DFWP — Montana Department of Fish, Wildlife and Parks
DHES — Montana Department of Health and Environmental Sciences
DNRC — Montana Department of Natural Resources and Conservation
EIS — environmental impact statement
EPA — United States Environmental Protection Agency
FERC — Federal Energy Regulatory Commission
GW — gigawatt
GWh — gigawatt-hour
kV — kilovolt
kW — kilowatt
kWh — kilowatt-hour
MCA — Montana Code Annotated
MEPA — Montana Environmental Policy Act
mg/l — milligrams per liter
MNHP — Montana Natural Heritage Program
MNRIS — Montana Natural Resources Information System
MPC — Montana Power Company
MW — megawatt
MWh — megawatt-hour
ppm — parts per million
SCS — United States Soil Conservation Service
SHPO — Montana Historical Society, State Historic Preservation Office
TDS — total dissolved solids
TSS — total suspended solids
µg/l — micrograms per liter
USDA — United States Department of Agriculture
USDI — United States Department of the Interior
USFS — United States Forest Service
USGS — United States Geological Survey

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION

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STATE OF MONTANA

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HELENA, MONTANA 59620-2301

January 8, 1992

TO ALL INTERESTED PERSONS:

This environmental impact statement (EIS) has been prepared by the Montana Department of Natural Resources and Conservation (DNRC) on behalf of the Board of Natural Resources and Conservation (Board). The EIS and supporting environmental assessments analyze the impacts on the environment from the proposed reservations of water in the Missouri River Basin above Fort Peck Dam.

Reservations of water have been sought by the following state and federal agencies and state subdivisions:

Conservation Districts:

Big Sandy
Broadwater
Cascade County
Chouteau County
Fergus County
Gallatin
Glacier County
Hill County
Jefferson Valley
Judith Basin
Lewis and Clark County
Liberty County
Meagher County
Lower Musselshell
Pondera County
Teton County
Toole County
Valley County

Municipalities:

Belgrade
Bozeman
Chester
Choteau
Conrad
Cut Bank
Dillon
East Helena
Fairfield
Fort Benton
Great Falls
Helena
Lewistown
Power
Shelby
Three Forks
West Yellowstone
Winifred

State Agencies:

Montana Department of Health and Environmental Sciences
Montana Department of Fish, Wildlife and Parks

Federal Agencies:

United States Bureau of Reclamation
United States Bureau of Land Management

On July 3, 1991, DNRC released a draft EIS. Informational meetings and public hearing on the draft EIS were held in Helena, Roundup, and Big Sandy on August 5, 1991; in Great Falls, Ennis and Valier on August 6, 1991; in Lewistown and Bozeman on August 7, 1991; and in Glasgow and Dillon on August 8, 1991. The 60-day comment period, originally scheduled to end September 2, 1991, was extended to September 16, 1991. DNRC received 121 written and oral responses on the draft EIS.

While not including any major changes from the draft EIS, the final EIS includes corrections, clarifications, and additions to the original text. Two new alternatives were considered - a municipal alternative and a water quality alternative - as the result of public comments. Public comments and DNRC's responses to the comments are also included.

The EIS does not recommend a course of action to the Board. The Board has appointed a hearing examiner to conduct a contested case hearing, which will begin in February 1992. Hearing times and locations where the public can give testimony will be published in newspapers of general circulation. Based on information in the applications, the EIS, and on testimony at the hearing, the hearing examiner will present findings and recommendations to the Board. The Board has until July 1, 1992, to make a final decision on the water reservation applications.

Further information, including additional copies of the final EIS, can be obtained by calling (406) 444-6627, or by writing to DNRC at 1520 E. Sixth Ave., Helena, MT, 59620-2301.

Sincerely,

Karen L Barclay

Karen L. Barclay
Director

MISSOURI RIVER BASIN

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR WATER RESERVATION APPLICATIONS ABOVE FORT PECK DAM

DNRC

Montana Department of
Natural Resources and Conservation

January 1992

SUMMARY

In July 1991, the Montana Department of Natural Resources and Conservation (DNRC) released its draft environmental impact statement (EIS) for water reservation applications above Fort Peck Dam. Informational meetings and public hearings on the draft EIS were held in 10 Missouri basin communities from August 5 through August 8. The public had until September 2 to comment on the draft EIS, with this deadline later extended to September 16. This final EIS responds to comments and questions pertaining to the draft EIS and summarizes and updates the draft.

MISSOURI RIVER WATER RESERVATION STATUTE

In 1985, the Montana Legislature directed DNRC to begin a basinwide water reservation proceeding for the Missouri River basin above Fort Peck Dam. The legislature felt that implementation of a water reservation procedure would encourage more coordinated development of the water resources in the basin and would help form a strong and unified basis for protecting Montana's share of the Missouri River water from downstream states. Reservations granted in this process have a priority date of July 1, 1985. Under Montana water law, reservations allow for existing or future consumptive uses of water and for maintaining instream flows to protect aquatic life, recreation, and water quality. Only public entities such as local governments, conservation districts, and state and federal agencies can apply for and hold water reservations. DNRC was assigned by statute to coordinate the process and to provide technical and financial assistance to conservation districts and municipalities in preparing their applications. The Board of Natural Resources and Conservation (Board) must reach a decision on water reservation applications above Fort Peck Dam by July 1, 1992.

APPLICATIONS

DNRC received 40 reservation applications. Eighteen municipalities applied for 34,689 acre-feet per year (af/yr) to meet future growth. Eighteen conservation districts requested 388,137 af/yr, primarily for 219 proposed irrigation projects covering 154,604 acres. The Montana Department of Health and Environmental Sciences (DHES) applied to reserve half the average annual flow at four points on the Missouri River (near Toston, Ulm, Virgelle, and Landusky) to maintain dilution of arsenic in the river water. The Montana Department of Fish, Wildlife and Parks (DFWP) applied to reserve instream flows on 283 streams or stream reaches, one lake, and one wetland, to protect fish, wildlife, recreation, and water quality. The U.S. Bureau of Land Management (BLM) requested instream flows on 31 streams for fish, wildlife, recreation, and to maintain channel form. The U.S. Bureau of Reclamation (BUREC) applied to reserve a maximum of 280 cubic feet per second (cfs), up to a yearly total of 89,000 acre-feet (af) from the Missouri River. This water would be diverted into the Milk River basin to relieve water shortages and provide for some new irrigation.

EIS PROCESS

The Montana Environmental Policy Act (MEPA) requires preparation of an environmental impact statement for major state government actions that have the potential to significantly affect the human and natural environment. An EIS examines the environmental, social, and economic impacts of the proposed action and is generally prepared in two phases—a "draft" and "final" EIS. Because the Missouri basin water reservation proceeding is a major state action that could have substantial effects on the environment, an EIS was prepared.

In the summer of 1989, DNRC held 10 public meetings at different locations throughout the basin to identify important issues for analysis and inclusion in the draft EIS. DNRC also developed a computer model of the Missouri River basin to assess the availability of water. The draft EIS included discussion of issues raised by meeting participants, along with analysis based on the computer modeling. Further information, research, and analysis was provided by DNRC staff and consultants. The draft EIS was distributed in July 1991.

Information meetings followed by hearings were held in 10 Missouri basin communities during August 5, 6, 7, and 8, 1991, to take comments and questions on the draft EIS (Table S-1). Distribution of the draft EIS was followed by a 60-day comment period during which DNRC accepted written comments on the draft EIS. This comment period was extended two weeks to end on September 16, 1991. DNRC received 86 written comments in response to the draft EIS. This final EIS was then prepared to respond to comments and questions pertaining to the draft, and to summarize and update information in it.

COMMENTS ON DRAFT EIS

Major issues raised in the comments pertained to the availability of water for the reservations; technical aspects of water law; appropriateness of a Board decision prior to completion of adjudication; how the reservations would affect water quality, particularly arsenic and sediment; appropriateness of methods used to determine instream flow requests and impacts to fisheries; and how the value of water for instream flow was determined. Many commenters indicated support or opposition to one reservation or another.

NEW INFORMATION

MPC proposes to upgrade several of its Missouri River hydroelectric generating facilities, increasing generating capacity by 68 megawatts (MW). Effects of each alternative on hydroelectric generation at the upgraded facilities were calculated and found to be small.

Table S-1. Public participation in meetings held to take comments on draft EIS

Meeting location	Number of people attending	Number of people making comments on draft EIS
Helena	13	3
Roundup	10	9
Big Sandy	2	0
Great Falls	13	2
Ennis	2	0
Valier	7	1
Lewistown	12	3
Bozeman	29	3
Glasgow	9	0
Dillon	101	14

Since publication of the draft EIS, the U.S. Fish and Wildlife Service (USFWS) has received a petition to list the fluvial (stream-dwelling) arctic grayling as an endangered species and to designate all waters in its former range as critical habitat. The only known population of fluvial arctic grayling in the lower 48 states today is in the Big Hole River drainage.

ALTERNATIVES

To address the full range of potential impacts and options available to the Board, DNRC selected four alternatives to analyze in the draft EIS: the Consumptive Use, Instream, Combination, and No Action alternatives. Two additional alternatives—the Water Quality and Municipal alternatives—were developed and analyzed in the final EIS in response to requests by a number of commenters.

DNRC also recalculated the benefits and costs of each alternative after refining assumptions about the value and timing of return flows, and after finding an error in Table 6-41 of the draft EIS.

Municipal reservations were given highest priority under all but the No Action and Water Quality alternatives because of the relatively small amount of water requested for municipal use.

The Consumptive Use Alternative emphasizes the use of water for irrigation and municipal purposes. First preference in this alternative goes to municipalities, followed by proposed irrigation projects, and then instream uses. This alternative would include water reservations for all irrigation projects proposed in the reservation applications.

The Instream Alternative gives first priority to municipal uses, but emphasizes instream reservations for the protection of fish, wildlife, recreation, and water quality. Irrigation would have third priority.

To some extent, the Combination Alternative is similar to the Consumptive Use Alternative in that it gives first preference to municipalities, second to proposed irrigation projects, and third to instream uses. It differs primarily in that proposed irrigation projects are only included if they are at least marginally economically and financially feasible. A few other projects were excluded or reduced in size on the basis of concerns about land use impacts or other environmental considerations.

The Water Quality Alternative includes only reservations for requested instream flows and, therefore, would not have any adverse effects on water quality. This alternative was developed in response to comments on the draft EIS.

The Municipal Alternative also was developed in response to comments on the draft EIS, which suggested benefits would be maximized if an alternative were developed that included all instream and municipal requests, but no new irrigation projects. Under this alternative, first preference is given to municipalities and second to instream reservations. No irrigation projects are included.

Under the No Action Alternative, DNRC describes trends that might unfold through the year 2025 if no reservations are granted.

BOARD AUTHORITY

The Board can grant, modify, or deny any or all of the reservation requests. Applicants must establish to the satisfaction of the Board the following four criteria:

a. the purpose of the reservation;
b. the need for the reservation;
c. the amount of water necessary for the reservation; and
d. that the reservation is in the public interest.

Besides these criteria, the Board also must ensure that the reservation applicants make progress toward development of the proposed use with reasonable diligence and that no reservations are granted that would adversely affect senior water rights. To make its decision, the Board will have to abide by the decision criteria described in Chapter Seven of the draft EIS and rely on information in the applications, draft and final EIS, individual environmental assessments, and on testimony presented at the contested case hearing.

IMPACTS UNDER CONSUMPTIVE USE, INSTREAM, COMBINATION, MUNICIPAL, AND WATER QUALITY ALTERNATIVES

GENERAL CONSIDERATIONS

Alternatives listed in order of decreasing impacts to the existing environment are the Consumptive Use Alternative, Combination Alternative, Instream Alternative, Municipal Alternative, and Water Quality Alternative. Some proposed consumptive use projects included in all but the Water Quality Alternative would have substantial impacts. Some impacts were not assessed for large projects where information was not available. A separate environmental review might be required before some of these projects could be constructed.

WATER QUANTITY AND DISTRIBUTION

Many rivers, streams, reservoirs, and groundwater systems have been altered by existing water uses and could be further modified by any consumptive use project developed through the use of reservations. Some streams have too little water in dry years to satisfy all existing water users. Impacts to streamflows would be greatest under the Consumptive Use Alternative, which would reduce flows substantially in the Jefferson, Smith, Sun, Marias, and Teton rivers, and in at least a dozen smaller tributary streams. In several of the rivers and streams, late summer streamflows would be reduced to zero or near zero during dry years. Streamflows would decrease less under the Combination Alternative than under the Consumptive Use Alternative. Streamflow reductions would be even less under the Instream Alternative, and only minor under the Municipal Alternative. Flows would not be affected under the Water Quality Alternative.

LEGAL WATER AVAILABILITY

While water may be physically available for a reservation at the point of diversion, it may already be appropriated by a water user downstream. Existing water users such as irrigators, Montana Power Company (MPC), BUREC, BLM, Indian tribes, and the Corps of Engineers already claim most of the flow in the Missouri River and its tributaries. The exact amount of water legally available for future consumptive appropriation, if any, will not be known for some time. The statewide water rights adjudication process will determine the size and extent of these water rights. The Board will need to find that existing water rights would not be adversely affected by the proposed reservations.

Canyon Ferry Dam was built to provide water for consumptive uses, primarily for irrigation, while at the same time maintaining the level of hydropower production at MPC's downstream facilities. Soon after Canyon Ferry Dam went into operation, releases from the reservoir increased MPC's downstream electricity generation by an annual average of 106 gigawatt-hours (1 gigawatt = 1,000 megawatts) above the pre-Canyon Ferry level. As more water was consumed for other purposes, the increase above the 1955 level decreased to an average of 84 GWh per year by 1986, and would decrease further to an average of 54 GWh per year under the Consumptive Use Alternative. In the two lowest power years in 10 under the present operating regime, MPC would receive no additional benefits from the reservoir at either the 1986 level of irrigation development or under the Consumptive Use Alternative. The problem of high arsenic concentrations in the Missouri River drainage still must be addressed before BUREC will market water stored in Canyon Ferry Reservoir for consumptive uses (see Water Quality).

The Blackfeet Tribes have substantial federal reserved water right claims on the Marias River and its tributaries, with a priority date of May 1, 1888. This special class of water rights might impact use of water reservations and existing water users.

WATER QUALITY

Water reservations for consumptive use would cause a decline in water quality in some streams and groundwater systems. Higher concentrations of nutrients, pesticides, sediments, and salts would be noticeable in some waters, but in most instances the increases would be minor. Short-term increases in sediments would result from construction of reservoirs and diversion structures.

Arsenic concentrations exceed the federal and state instream standards in the Madison and Missouri rivers in Montana. These concentrations also exceed the federal drinking water standard in the Madison River and the portion of the Missouri River upstream from Toston Dam. Arsenic is a known carcinogen. The Environmental Protection Agency (EPA) standard for carcinogens is based on a risk level that would result in one case of skin cancer per million people. Based on arsenic concentrations in the Missouri River, the EPA standard, and assumptions made by EPA in deriving the standard, the risk of skin cancer from arsenic is as high as one case per 77 people at West Yellowstone, and drops to about one case in 10,000 people near Landusky. At Toston, the risk of cancer is about one case per 666 people.

Reservations that lead to consumptive water use in the Missouri River basin could increase the concentration of arsenic in the Missouri River and adjacent groundwater systems. Consequently, the risk of skin cancer for people who rely on Missouri River water for drinking would increase unless the arsenic is removed through special treatment. Such treatment is expensive and requires extensive processing facilities. Proposed irrigation projects diverting water from the Madison River into the Gallatin drainage and from the Missouri River into the Milk drainage would increase arsenic levels in the Gallatin and Milk rivers. Instream reservations would not change water quality and would not be adequate to preserve flows for dilution of arsenic to meet EPA standards.

SOILS AND STREAM CHANNEL FORM

In general, reservations that would result in the conversion of rangeland to irrigation would affect soils through the loss of organic matter, reduced water holding capacity, and increased susceptibility to erosion. These effects would be offset somewhat once an alfalfa crop is established. Where reservations convert dry cropland to irrigation, soil structure will improve, erosion will decrease, and nitrogen and organic fertility will increase. Forty-three projects might have substantial soil impacts and these are identified in Chapter Six of the draft EIS. Other effects of consumptive use projects on soils are generally minor.

Impacts to stream channels generally would be minor. In some instances, consumptive water uses could decrease channel capacity by increasing the deposition of sediment. Instream reservations would not change existing stream channel forms.

LAND USE

Proposed irrigation reservations would convert nonirrigated cropland, pasture, and rangeland to irrigated fields. The amount of newly irrigated cropland would increase in the basin by about 17 percent (150,248 acres) under the Consumptive Use Alternative, 9 percent (77,759 acres) under the Combination Alternative, and 4 percent (36,775 acres) under the Instream Alternative. No increases would occur under the Municipal or Water Quality alternatives. Forty-two irrigation projects may have other substantial land-use impacts and these are identified in the draft EIS. Other land use impacts are generally minor.

FISH AND AQUATIC HABITAT

Low flow conditions already stress gamefish populations and aquatic habitat on some rivers and streams in the basin. Further consumptive uses would generally worsen conditions on these rivers and streams. Streams most severely affected by the proposed consumptive use reservations include the Jefferson River near Waterloo and Three Forks, the Boulder River above Cold Springs, the Marias River, the lower portions of the Sun and Teton rivers, and eight tributaries. Streams where there also would be impacts, although the effects could be less, include the Gallatin, Missouri, Judith, Dearborn, and Smith rivers and seven smaller tributary streams. Stored water could be released from Tiber Reservoir to offset most water depletions in the lower Marias River. Reservations for instream flows would help maintain the existing aquatic habitat and fisheries.

The effects of flow reductions on the pallid sturgeon, a federally listed endangered species, are not known. The arctic grayling has been proposed for listing as an endangered species. Nearly all reservations for consumptive use are located downstream from the present range of the grayling.

It is possible that four of the proposed storage projects could support a fishery. On large irrigation projects, fish could be killed in the diversion structures, though this could be minimized through proper design.

WILDLIFE

Proposed irrigation projects could affect wildlife by altering habitat. Thirty-six irrigation projects would convert native grassland to irrigated cropland on big game winter range and would reduce the amount of native forage available to wintering elk and deer. Losses of winter range could stress wildlife during the winter and early spring and increase depredation on crops and hay. DFWP has identified 70 proposed irrigation projects with a high potential for crop damage from wildlife. Most of these projects are near or within existing winter ranges.

Birds of prey (raptors), waterfowl such as ducks and geese, and aquatic mammals such as mink and river otter could be affected by consumptive use reservations. However, in most cases, site-specific information is not available to determine the extent of the effect, if any. Grouse and birds of prey would be affected by local disturbance during nesting and brood rearing periods. Reduced streamflows would make waterfowl more vulnerable to predation and also would limit food supplies for aquatic mammals, which would render them more susceptible to predation.

VEGETATION

Impacts to vegetation would result from replacement of natural plant communities with agricultural crops, inundation of riparian and upland plant communities by reservoirs, reduced streamflows, and increased proliferation of noxious weeds. However, it is difficult to predict the level of impacts on riparian and wetland plant species such as cottonwoods, sedges, rushes, and dominant tree species. No Montana plants are federally listed as threatened or endangered species. Probably the most significant vegetation effect is the increased risk of spreading noxious weeds.

HISTORICAL, ARCHAEOLOGICAL, AND PALEONTOLOGICAL SITES

Proposed consumptive use reservations would affect 60 known historical, archaeological, or paleontological sites. Most sites are located on private land where formal evaluation is not required to determine if some sites might be eligible for listing on the National Register of Historic Places.

STORAGE

Reservations may reduce water available for future storage projects. Reservations generally would not preclude storage of spring runoff flows, but might make some storage projects less economically feasible. Existing water rights could be a greater constraint to the development of new storage than water reservations. Development of consumptive use reservations would slightly decrease reservoir levels in Canyon Ferry, Fort Peck, and Tiber reservoirs. The reservation applications include 15 water storage projects, and together they would store a relatively small amount of water.

RECREATION

Instream reservations would help maintain streamflows on streams and rivers that are important to recreation and tourism. Recreational use of water in the Missouri River basin in Montana totaled more than 2 million recreation days in 1989. About 61 percent of the total water-based recreation use is on rivers and streams and 39 percent on reservoirs. The most important recreational resources in the basin from an economic perspective are the streams in the Headwaters subbasin such as the Beaverhead, Big Hole, Gallatin, and Madison rivers. The total net economic value of water-based recreation in the basin above Fort Peck Dam is $144 million per year.

Recreational use could decline under all alternatives that include consumptive use. The effects would become more severe as additional water is withdrawn from streams that already have low flows during dry years, such as the Gallatin, Jefferson, Boulder, Smith, Dearborn, Sun, Teton, Judith, and Musselshell rivers, Belt Creek, and the Marias River above Tiber Reservoir.

Estimated recreational instream values range from $35 an acre-foot on headwater rivers and streams during July and August to $2 an acre-foot on Middle Missouri and Marias/Teton subbasin streams during the rest of the year. Estimated recreation losses are $3,754,000 per year under the Consumptive Use Alternative; $1,616,000 per year under the Combination Alternative; $307,000 per year under the Instream Alternative; and $3,930 per year under the Municipal Alternative. No recreation losses are expected under the Water Quality Alternative.

HYDROPOWER

Consumptive use of water under the requested reservations eventually would increase the cost of electricity to ratepayers by: (1) increasing the use of electricity to operate municipal and irrigation pumps; and (2) decreasing streamflows that are used to generate electricity. These two actions would require production of replacement power from new sources that would be considerably more expensive than existing power supplies. The total monetary impact to ratepayers would range from $11.0 to $29.2 million per year under the Consumptive Use Alternative; $4.7 to $13.4 million per year under the Combination Alternative; $1.4 to $4.4 million per year under the Instream Alternative; and $0.09 to $0.5 million per year under the Municipal Alternative. The Water Quality Alternative would not directly affect ratepayers. The cost of replacing power used under the Consumptive Use Alternative (in excess of revenue received for irrigation and municipal pumping) would range from $1.8 to $11.0 million per year; $1.0 to $6.1 million under the Combination Alternative; $0.4 to $2.4 million under the Instream Alternative; and $.09 to $0.52 million under the Municipal Alternative.

AGRICULTURE

Development of irrigation projects in the basin under any alternative would have a small beneficial effect on jobs, personal income, taxes, and agricultural sales. About 30 jobs would be created in the basin under the Instream Alternative, about 53 under the Combination Alternative, and about 106 under the Consumptive Use Alternative. No new jobs would be created in the agricultural sector under the Municipal or Water Quality alternatives. Total personal income in the basin would increase between $1,749,723 in the Instream Alternative and $6,066,878 per year under the Consumptive Use Alternative. County tax receipts would increase between $59,563 for the Instream Alternative and $158,440 per year under the Consumptive Use Alternative. Agricultural sales would increase between 1.0 percent and 3.5 percent. Agricultural sales, personal income, and county tax receipts would not increase under the Water Quality Alternative.

SOCIAL EFFECTS

The reservations would not noticeably change the social character of communities in the Missouri River basin. The agriculture community would remain stable, and the recreation and tourism-related services would constitute a growing segment of the basin economy.

NO ACTION ALTERNATIVE

If the Board were to deny all reservation applications, consumptive water users could still apply through the water use permitting process to appropriate water for beneficial uses. If most or all direct flows are appropriated by water users such as MPC and irrigators, a potential user could buy an existing water right and change the use. Municipalities could condemn existing water rights to meet future needs.

If instream reservations are not granted, instream flows in many streams and rivers would not be protected by a water right. In some instances, increased consumptive uses could lead to streams becoming very low or going dry, resulting in adverse impacts to water quality, aquatic life, recreation, and wildlife. Murphy water rights, large hydropower water rights, and federal and state water quality standards for arsenic would provide some level of instream flow protection in some streams and rivers.

If present trends hold, few large storage projects will be built over the next 25 years. Emphasis during this period probably will be on rehabilitation and enlargement of existing facilities as defined in the state water plan.

BOARD DECISION CRITERIA

The decision of whether to grant, modify, or deny the reservation applications rests with the Board, which must abide by several criteria that are discussed below. The ability of the requested reservations to meet these criteria is examined in DNRC's research and analyses of the reservation applications, as explained in Chapter Seven of the draft EIS. These results are preliminary and do not represent conclusions on whether any reservation request satisfies any of these criteria. Such determinations are made by the Board.

QUALIFICATION AND PURPOSE

All those who applied for reservations were found to be qualified to reserve water through the Missouri River basin water reservation proceeding. The purposes for all reservation requests are beneficial uses under Montana law.

NEED

A water reservation is needed if "there is a reasonable likelihood that future instate or out-of-state competing water users would consume, degrade, or otherwise affect the water available for the purpose of the reservations," or if "there are constraints that would restrict the applicant from perfecting a water permit for the intended purpose of the reservation." All applicants claimed a need to reserve water. Conservation districts want to secure water for agricultural production before the water is appropriated by other users in Montana or by downstream states. They also want to have the option to develop this water when the economic climate improves. Municipalities want to appropriate water to meet future growth in the basin. DFWP and BLM want to have secure instream flows to protect fish, wildlife, recreation, and water quality. DHES wants to secure instream flows to protect the public from increased risk of cancer from arsenic concentrations that are already high. BUREC intends to divert Missouri River water to reduce shortages in the Milk River basin.

AMOUNT

The Board must determine the amount needed to fulfill the purpose of the reservations. This amount must be based on accurate and suitable measuring methods and determinations that no reasonable cost-effective measures could be taken within the reservation term to increase efficiency and lessen the amount of water required.

Conservation districts' requests are based on recorded crop requirements and efficiency of proposed irrigation systems. Most of the projects were designed for efficient sprinkler irrigation.

The three agencies that requested instream flows used various methods for determining their requested water reservations. DFWP employed several methods, but primarily used the Wetted Perimeter Inflection Point Method (WETP). This method provides an indication of streamflows necessary to maintain aquatic habitat in riffle areas. BLM used the same wetted perimeter method to determine yearly minimum flows, but also used channel geometry methods developed by the U.S. Geological Survey (USGS) for determining flows necessary to maintain channel stability. DHES's position is that any new consumptive use development would increase arsenic concentrations and the consequent cancer risk from Missouri River water, and that all remaining unappropriated flows are needed to protect public health. Under the law, however, DHES can request no more than half the average annual flow on gauged streams. This is the amount DHES requested at four points on the Missouri River.

Municipalities requested enough water to service estimated population growth to the year 2025. The amount of water needed was normally calculated by multiplying the per capita rate of consumption times the estimated population. Per capita use rates were generally based on actual use requirements for each community. Long-term census information indicates that 11 of the 18 municipal projections of population growth, and the associated amounts of water requested, may be higher than actually would occur.

BUREC based the amount of its request on estimated supplemental water requirements for land that is already irrigated when water is available along the Milk River and on the Fort Belknap Indian Reservation, and the water needed to irrigate land that is not now irrigated on the Rocky Boy's Indian Reservation and along the proposed canal. Present and future water conservation measures will relieve some of the water shortages in the basin. Since it is not known how much water will be saved through conservation nor the actual amount the tribes will need to satisfy their federal reserved water rights, it is difficult to determine the adequacy of the amount that BUREC requested in its application for the Virgelle diversion project.

PUBLIC INTEREST

The public interest criteria requires in part that the benefits of the reservation exceed the costs. Reservations for municipal water supplies and irrigation would provide monetary benefits to basin communities. However, they would result in costs by causing streamflow reductions that could adversely affect recreation and hydropower production. Reservations for consumptive uses also would increase the electrical power load, which eventually would require the production of electricity from new sources. New sources of power tend to cost more than existing power sources. Therefore, decreased hydroelectric generation combined with increased power loads would raise electricity costs for all users. Table S-2 identifies the net benefits and net costs of water uses under the five alternatives. Total net benefits are greatest under the Instream Alternative ($327.2 million), slightly less under the Municipal Alternative ($322.0 million) and Combination Alternative ($305.1 million), considerably lower under the Consumptive Use Alternative ($151.3 million), and zero under the Water Quality Alternative.

The value of an acre-foot of water for instream and consumptive uses can be compared when reservations for the two uses are both requesting the same water. Instream values include the value of water used for recreation, plus the value of water used for hydroelectric generation. In determining the value of water for the proposed irrigation projects, DNRC examined three ways the timing of return flows affect the value of water. DNRC assumed that replacement power used to replace that lost due to reduced flows and to satisfy increased power loads for consumptive use projects would cost between 5 and 10 cents/kilowatt-hour (kWh).

At least 10 and as many as 59 of the 219 proposed irrigation projects would have a value per acre-foot of water that is greater than the value of water used for instream purposes, given a 5 cent/kWh power cost. The value of water for at least 1 and as many as 4 of the proposed irrigation projects would be greater than the value of water used for instream purposes, given a 10 cent/kWh electricity cost. The estimated value of an acre-foot of water for all municipal reservations exceeds the estimated value for instream flow and proposed irrigation projects. Instream flow values are greatest in the Headwaters subbasin where the recreation value is the highest and where each acre-foot of water can be passed along to be used to generate hydroelectricity at downstream hydropower facilities. Instream values decline progressively with distance downstream, but the value of water for irrigation remains more consistent throughout the basin.

On each stream or stream reach, the potential net benefit is based on the assumption that water is available. However, in some instances, water may not always be available.

RECOMMENDATIONS

DNRC is not recommending a course of action to the Board. The Board has appointed a hearings examiner to conduct a formal contested case hearing that will begin in February 1992. Based on information in the applications and the EIS and on testimony at the hearing, the hearings examiner will present findings and recommendations to the Board. The Board has until July 1, 1992, to make its decision on the water reservation applications.

Table S-2. Economic benefits and costs under five alternatives ($ million)[a]

	Consumptive	Instream	Combination	Municipal	Water Quality
Irrigation	$134.1	$38.7	$112.6	$0.00	$0.00
Municipal	$324.0	$324.0	$324.0	$324.0	$0.00
Recreation	-$78.3	-$6.4	-$33.7	-$0.1	$0.00
Hydropower production	-$190.3	-$20.8	-$76.6	$0.1	$0.00
Replacement power	-$38.1	-$8.3	-$21.2	-$1.8	$0.00
TOTAL	$151.3	$327.2	$305.1	$322.0	$0.00

[a] Positive numbers represent net benefits and negative numbers represent net costs.
All figures are the value today of 70 years of future impacts based on a 4.6 percent real discount rate.

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CHAPTER ONE

INTRODUCTION

This chapter provides background information on the water reservation process in the Missouri River basin, on Montana water law, and on the applications. Chapter Two presents information that was obtained or developed by DNRC subsequent to preparation of the draft EIS. Responses to comments on the draft EIS are presented in Chapter Three, along with changes that have been made to the draft EIS.

In July 1991, DNRC released its EIS for water reservation applications in the Missouri River basin above Fort Peck Dam. Informational meetings and public hearings on the draft EIS were held in 10 Missouri basin communities from August 5 through August 8, 1991. The public had until September 2 to comment on the draft EIS, with this deadline later extended to September 16, 1991. This final EIS responds to comments and questions pertaining to the draft EIS and summarizes and updates the draft.

BACKGROUND

In 1985, the Montana Legislature directed DNRC to initiate and coordinate a proceeding that allows public entities (state and federal agencies and subdivisions of the state) to reserve water in the Missouri River basin of Montana for future use. This reservation proceeding was initiated for two reasons. First, it was thought that the comprehensive planning required in a reservation process would encourage more efficient development of the water resources in the basin. Second, the reservation proceeding was seen as a way to build a strong legal basis for protecting Montana's share of Missouri River water in any future litigation with other states or in a congressional apportionment of the water among states.

The legislature was particularly concerned that downstream states might litigate for the guaranteed delivery of Missouri River flows from Montana. Montana can best prepare for negotiation or litigation by identifying its present and future water needs and legally reserving water in amounts sufficient to meet those needs.

In reservation proceedings, local governments, conservation districts, and state and federal agencies were authorized to apply to reserve water for existing and future water-consuming uses or to maintain a minimum flow, level, or quality of water (§85-2-316, MCA). Under the law, DNRC is responsible for assisting in preparing the reservation applications and for coordinating the reservation process. The Board of Natural Resources and Conservation (Board), a governor-appointed group of seven citizens, decides whether to grant, deny, or modify reservation requests. The Board's decisions on reservation applications in the Missouri basin will be based on a record of evidence that includes the information provided in the applications, the EIS, and a contested case hearing.

Due to the vast size of this basin, the Missouri reservation proceeding has been split into two parts. Applications for water in the upper portion of the basin, which encompasses the drainage area upstream from Fort Peck Dam, are being considered first. After an environmental review and contested case hearing, final decisions on the upper basin applications will be made by the Board before July 1, 1992. The draft EIS addressed only those applications for the reservation of water in the basin upstream from Fort Peck Dam. Applications for water in the basin below Fort Peck Dam and in the Little Missouri and Milk River basins had to be compiled by July 1, 1991, and will undergo similar review and hearings. The Board has until December 31, 1993, to act on these applications. Any reservation granted in either the upper or lower portion of the basin will receive a July 1, 1985, priority date (except for the Little Missouri River basin, where the priority date will be July 1, 1989).

EIS PROCESS

This EIS was prepared to satisfy the Montana Water Use Act and MEPA. MEPA requires that an EIS be prepared to address government actions that might significantly affect the quality of the environment. DNRC determined that the reservations, if granted, would meet these criteria and that preparation of an EIS was required. This EIS provides information for the Board to use in deciding whether it should grant, modify, or deny water reservations that have been applied for in the Missouri basin. It also serves to inform the public of the possible environmental consequences of any action by the Board on the pending water reservation applications.

The EIS addresses all pending water reservations requested in the basin above Fort Peck Dam and describes in general terms the reservation requests and the parties and resources that would be affected if the requests are granted. The effects of granting the reservations are the main focus of the EIS.

Detailed environmental assessments were completed on all reservation applications. These assessments were used in preparing the draft EIS and were available for review by contacting DNRC in Helena.

The public has had several opportunities to participate in the EIS process. In the first of these, public meetings were held at 10 locations in the summer of 1989 to help determine the issues that should be examined in the EIS. These issues, along with information from state and federal agencies, were combined with research results and other data to form the basis for the draft EIS. DNRC held 10 public hearings to gather written and oral comments. This final EIS contains DNRC's responses to comments and provides information on issues raised following publication of the draft EIS.

CONTESTED CASE HEARING

While the final EIS was being prepared, DNRC issued legal notice of the reservation applications to water right holders and other interested parties, and accepted written objections. The Board then appointed a hearings examiner, and a formal contested case hearing was scheduled to be held beginning in February 1992. At the hearing, reservation applicants and objectors can present testimony and evidence. Testimony will be taken from parties for limited purposes at Lewistown, Great Falls, Bozeman, Dillon, and Glasgow. This is the final opportunity for public involvement. After the contested case hearing, the hearings examiner reviews the evidence and information and presents findings of fact, conclusions of law, and recommendations to the Board. Based on its review of this record, the Board issues an order to fully grant, partially grant, modify, or deny requested reservations.

WHO HAS APPLIED

The application deadline for water reservations in the basin above Fort Peck Dam was July 1, 1989. DNRC received applications from 18 conservation districts, 18 municipalities, BUREC, DFWP, DHES, and BLM. A more detailed discussion of the applicants' requests are presented in the draft EIS. Tables 1-1 through 1-6 on the following pages identify the amount of water requested by each applicant, and maps 1-1 through 1-11 show where the reserved water would be used.

Table 1-1. Conservation district reservation requests

Project Number	---------Point of Diversion-------- TWN	RGE	SEC	Peak Flow (cfs)	Annual Diversion (af)	Water Source	Project Acres
Big Sandy							
BS-31	T29N	R9E	31	0.49	74	Marias River	32
BS-32	T29N	R9E	30	9.86	1,506	Marias River	639
BSS-2	T29N	R9E	30	289.61	44,608	Marias River	19,230
							19,901
Broadwater							
BR-5	T9N	R1E	25	2.98	362	Canyon Ferry Lake	182
BR-11	T9N	R1E	27	0.98	119	Canyon Ferry Lake	60
BR-12	T9N	R1E	27	1.31	159	Canyon Ferry Lake	80
BR-14	T8N	R1E	23	5.64	746	Canyon Ferry Lake	375
BR-28	T7N	R3E	32	1.88	249	Well (Deep Creek)	125
BR-29	T7N	R3E	30	0.69	84	Well (Deep Creek)	30
BR-34	T6N	R2E	33	3.76	497	Missouri River	250
BR-35	T5N	R1E	5	3.76	497	Well (Crow Creek)	250
BR-38	T5N	R2E	22	0.63	109	Well (Warm Springs Creek)	80
BR-40	T4N	R1E	4	1.07	126	Well (Warm Springs Creek)	125
BR-41	T4N	R1E	10	4.26	506	Well (Warm Springs Creek)	500
BR-42	T4N	R1E	2	0.68	81	Well (Warm Springs Creek)	80
BR-44	T4N	R1E	21, 28	9.40	1,243	Well (Warm Springs Creek)	625
BR-50	T3N	R2E	23	4.92	596	Missouri River	300
BR-52	T2N	R1E	27, 28	0.66	80	Jefferson River	40
BR-101	T2N	R2E	18	77.40	11,515	Jefferson River	3,190
BR-103	T9N	R1E	10	34.10	5,066	Canyon Ferry Lake	1,700
BR-104	T8N	R2E	17	151.40	22,491	Canyon Ferry Lake	6,095
BR-106	T10N	R1E	30	5.58	676	Canyon Ferry Lake	340
BR-107	T10N	R1E	29	2.30	278	Canyon Ferry Lake	140
BR-108	T9N	R1E	11	1.89	229	Canyon Ferry Lake	115
BR-109	T9N	R1E	14	2.13	258	Canyon Ferry Lake	130
BR-110	T9N	R2E	6	3.85	467	Canyon Ferry Lake	235
BR-111	T5N	R2E	36	0.66	80	Missouri River	40
							15,087
Cascade County							
CS-21	T20N	R2W	5	0.95	140	Big Coulee	56
CS-31	T21N	R1W	33	0.79	94	Sun River	38
CS-32	T21N	R1W	32	0.70	87	Sun River	35
CS-42	T20N	R6E	24	5.94	443	Belt Creek	124
CS-43	T20N	R6E	24	3.98	599	Belt Creek	255
CS-44	T20N	R7E	18	0.55	83	Belt Creek	35
CS-51	T21N	R1W	33	1.53	177	Sun River	70
CS-52	T20N	R1W	8	0.72	90	Sun River	36
CS-61	T19N	R2E	15	1.15	163	Smith River	79
CS-62	T17N	R2E	25	1.06	141	Hound Creek	59
CS-63	T17N	R2E	25	1.83	129	Hound Creek	42
CS-64	T17N	R2E	24	0.83	100	Hound Creek	42
CS-71	T15N	R4E	30	0.30	42	Smith River	17
CS-101	T18N	R1W	25	2.15	304	Missouri River	148
CS-102	T17N	R1W	11	1.39	186	Missouri River	79
CS-111	T19N	R2E	20	6.58	799	Missouri River	381
CS-159	T21N	R7E	32	0.76	114	Belt Creek	48
CS-171	T21N	R1W	35	0.50	70	Sun River	28
CS-231	T20N	R1W	2	0.18	26	Sun River	10
CS-241	T21N	R1E	26	1.48	190	Sun River	76
CS-251	T19N	R2E	26	1.65	245	Smith River	91
CS-252	T19N	R2E	15	0.57	77	Smith River	28
CS-271	T19N	R2E	23	0.93	134	Smith River	50
CS-331	T18N	R2E	26	0.41	57	Smith River	24
CS-351	T18N	R1W	35	2.73	369	Missouri River	171
CS-471	T21N	R1W	28	0.92	126	Sun River	50
CS-541	T19N	R2E	8	0.54	69	Missouri River	30
CSI-11	T17N	R1W	20	2.23	287	Missouri River	120
CSI-12	T17N	R1W	20	0.90	110	Missouri River	46
CSI-21	T17N	R1W	16	1.50	157	Missouri River	66
CSI-22	T17N	R1W	11	1.19	163	Missouri River	69

Project Number	Point of Diversion			Peak Flow (cfs)	Annual Diversion (af)	Water Source	Project Acres
	TWN	RGE	SEC				
CSI-23	T17N	R1W	11	1.61	144	Missouri River	61
CSI-31	T17N	R1W	2	0.82	109	Missouri River	46
CSI-32	T17N	R1W	1	0.65	86	Missouri River	36
CSI-33	T18N	R1E	30	1.10	150	Missouri River	62
CSI-34	T18N	R1E	18	1.17	164	Missouri River	60
CSI-35	T18N	R1E	17	1.69	253	Missouri River	108
CSI-41	T18N	R3E	12	1.44	180	Missouri River	66
CSI-51	T19N	R2E	19	1.78	250	Missouri River	92
CSI-52	T19N	R2E	8	4.65	700	Missouri River	298
CSI-71	T20N	R2W	4	1.32	198	Sun River	79
CSI-81	T21N	R1E	34	0.71	96	Sun River	38
CSI-82	T21N	R2E	31	1.03	137	Sun River	55
CSI-83	T21N	R2E	30	0.49	99	Sun River	39
CSI-91	T21N	R2E	34	0.98	129	Sun River	47
CSI-92	T20N	R3E	6	0.50	72	Sun River	26
CSI-101	T19N	R2E	4	1.57	223	Missouri River	108
CSI-102	T19N	R2E	9	1.28	171	Smith River	72
CSI-103	T19N	R2E	11	3.71	557	Missouri River	237
CSI-111	T18N	R2E	2	6.32	843	Smith River	387
CSI-120	T17N	R3E	20	1.17	133	Smith River	56
CSS-200	T20N	R3E	8	82.02	11,885	Sun River	5,053
							9,429
Chouteau County							
CH-21	T25N	R1E	31	2.64	406	Missouri River	175
CH-181[a]	T21N	R14E	7	0.00	38	Cut Bank Coulee	—
CH-201	T22N	R9E	35	0.54	77	Shonkin Creek	29
CH-211	T23N	R7E	7	2.94	382	Missouri River	142
CH-371	T25N	R9E	32	0.22	30	Missouri River	11
CH-381	T24N	R6E	5	9.90	1,912	Teton River	584
CH-511	T23N	R6E	34	10.24	1,577	Missouri River	680
CH-541	T22N	R6E	22	0.21	37	Highwood Creek	13
CH-551	T21N	R7E	12	0.64	86	Spring, Big Sag Coulee	32
CH-641[b]	T24N	R4E	33	0.00	53	Alkali Coulee	—
CHI-10	T25N	R10E	20	2.36	314	Missouri River	116
CHI-21	T25N	R10E	8	5.29	752	Missouri River	280
CHI-22	T25N	R10E	2	3.06	389	Missouri River	144
CHI-30	T26N	R11E	10	4.19	643	Missouri River	279
CHI-40	T26N	R12E	5	1.89	290	Missouri River	126
CHI-51	T25N	R9E	11	1.63	244	Marias River	98
CHI-52	T26N	R9E	32	3.33	255	Marias River	73
CHI-53	T25N	R9E	10	1.88	289	Marias River	125
CHI-61	T25N	R7E	33	1.72	247	Teton River	107
CHI-72	T24N	R6E	11	0.69	107	Teton River	46
CHI-74	T24N	R7E	6	0.69	106	Teton River	46
CHI-80	T25N	R5E	28	0.80	122	Teton River	53
CHS-1	T21N	R6E	25	20.23	3,117	Belt Creek	1,343
CHS-3	T23N	R7E	8	127.62	19,654	Missouri River	8,475
CHS-5	T25N	R9E	36	58.81	9,058	Missouri River	3,905
CHS-6	T25N	R10E	21	232.95	35,814	Missouri River	15,382
							32,264
Fergus County							
FE-41	T19N	R16E	27	0.85	103	Judith River	61.3
FE-42	T19N	R15E	27	0.38	44	UT Campbell Coulee	23.0
FE-81	T18N	R15E	2	3.33	403	Wolf Creek	239.2
FE-111	T15N	R18E	25	0.21	25	Big Spring Creek	12.0
FE-141	T15N	R18E	7	3.23	375	Wolverine Creek	222.3
FE-161	T17N	R17E	23	2.16	261	Lincoln Ditch	155.1
FE-401	T14N	R19E	23	0.55	64	East Fork Big Spring Creek	38.2
FE-431	T15N	R18E	21	1.06	107	Little Casino Creek	55.0
FE-561	T17N	R17E	16	3.30	382	Warm Springs Creek	227.5
FE-671	T14N	R16E	19	6.43	748	Olsen Creek	443.4
FE-672	T14N	R16E	19	3.82	444	UT Olsen Creek	263.8

[a] No irrigated acres. Storage will be used for fire protection and recreation.

[b] No irrigated acres. Storage will be used for wildlife enhancement.

UT - Unnamed tributary

Project Number	Point of Diversion			Peak Flow (cfs)	Annual Diversion (af)	Water Source	Project Acres
	TWN	RGE	SEC				
FE-673	T14N	R16E	30	1.13	131	UT Ross Fork Creek	77.7
FEI-10	T23N	R16E	27	1.59	192	Missouri River	114.0
FEI-20	T23N	R22E	36	2.20	262	Missouri River	134.0
FEI-30	T22N	R15E	5	0.75	90	Missouri River	53.7
FEI-40	T18N	R16E	28	13.69	1,592	Warm Springs Creek	944.3
FEI-50	T17N	R16E	27	63.48	7,381	Judith River	4,218.3
							7,282.8
Gallatin							
GA-13	T2S	R5E	34	1.34	106	Well	170
GA-14	T2S	R5E	25	0.63	50	Well	80
GA-24	T2S	R5E	5	1.84	146	Well	234
GA-35	T2S	R4E	27	0.63	71	Well	30
GA-40	T2S	R4E	24	0.94	75	Well	120
GA-41	T2S	R5E	36	1.26	100	Well	160
GA-44	T2S	R5E	3	2.20	175	Well	280
GA-46	T2S	R5E	26	1.26	100	Well	160
GA-79	T1S	R5E	9	4.53	509	Well	300
GA-81	T1S	R4E	3	3.47	390	Well	230
GA-92	T3N	R5E	32	0.91	102	Well	60
GA-102	T1N	R1E	8	2.34	250	Jefferson River	100
GA-110	T1N	R4E	22	1.57	113	Well	104
GA-124	T1N	R5E	34	0.71	56	Well	90
GA-130	T1N	R4E	21	2.11	152	Well	140
GA-143	T1N	R5E	28	4.40	474	Well	330
GA-151	T1N	R6E	17	0.45	51	Well	30
GA-201	T2S	R2E	6	118.35	12,249	Madison River	7,890
							10,508
Glacier County							
GL-11	T34N	R8W	32	3.72	472	Cut Bank Creek	277
GL-201	T30N	R9W	21	3.35	220	Whitetail Creek	86
GL-221	T34N	R7W	22	4.37	579	Cut Bank Creek	340
							703
Hill County							
HI-269	T29N	R8E	26	18.82	2,708	Marias River	1,350.1
Jefferson Valley							
JV-17	T5N	R3W	29	1.87	129	Well	170
JV-18	T5N	R3W	33	1.10	76	Well	100
JV-25	T1S	R5W	32	0.53	59	Jefferson River	35
JV-55	T1N	R3W	10	1.86	192	Jefferson River	85
JV-63	T4N	R2W	29	0.82	99	Well	50
JV-80	T3N	R2W	19	0.96	67	Well	80
JV-81	T3N	R2W	31	1.31	159	Well	80
JV-95	T1N	R5W	14	14.43	1,749	Jefferson River	440
JV-201	T2S	R6W	23	80.30	11,022	Jefferson River	4,175
JV-202	T1S	R5W	14	88.90	12,177	Jefferson River	4,950
JV-203	T1N	R2W	26	35.80	5,313	Jefferson River	1,765
JV-204	T2S	R6W	23	7.42	703	Jefferson River	405
							12,335
Judith Basin							
JB-21	T15N	R14E	16	0.22	27	Louse Creek	13
JB-61	T17N	R8E	32	2.15	275	Little Otter Creek	154
JB-111	T17N	R10E	18	0.98	131	McCarthy Creek	74
JB-231	T15N	R13E	26	0.75	92	Well	44
JB-232	T15N	R13E	23	0.75	92	Well	44
JB-261	T14N	R11E	6	3.68	56	Running Wolf Creek	21
JB-281	T17N	R8E	3	0.44	28	Otter Creek	10
JB-309	T13N	R15E	1	0.39	45	Little Trout Creek	23
JBI-2	T14N	R14E	16	13.11	1,615	Judith River	904
JBS-3	T17N	R12E	29	3.26	401	Wolf Creek	225
							1,511
Lewis and Clark County							
LC-11	T10N	R4W	13	0.60	80	UT Ten Mile Creek	30
LC-131	T20N	R6W	2	1.03	151	Elk Creek	60
LC-210	T15N	R3W	21	1.25	148	Missouri River	62

UT - Unnamed tributary

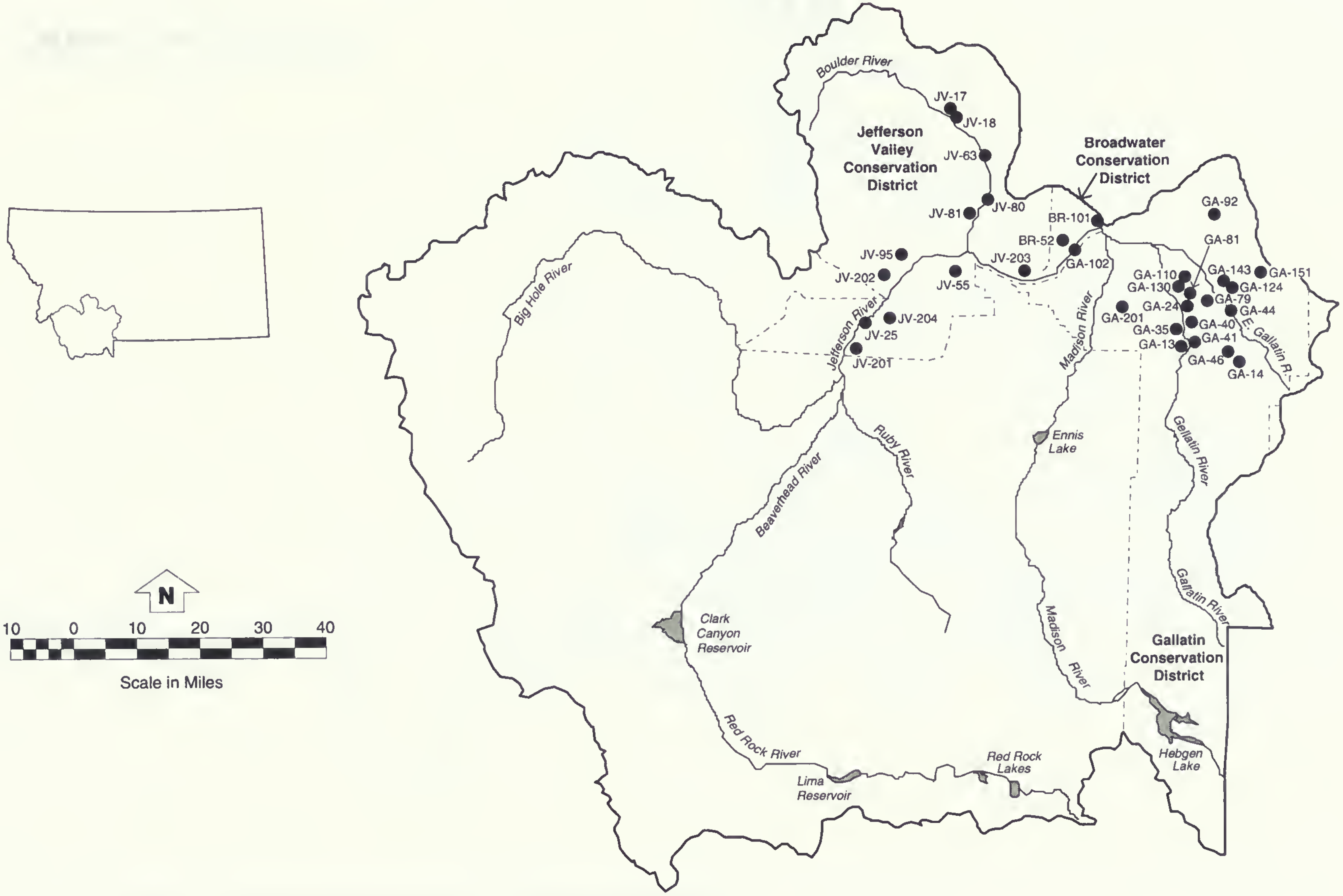
Project Number	Point of Diversion			Peak Flow (cfs)	Annual Diversion (af)	Water Source	Project Acres
	TWN	RGE	SEC				
LC-251	T20N	R6W	25	1.82	281	Smith Creek	130.7
LCI-10	T12N	R3W	11	1.22	185	Upper Holter Lake	81.1
LCI-20	T17N	R5W	25	2.51	355	Dearborn River	173.1
							536.9
Liberty County							
LI-91	T29N	R6E	18	3.49	503	Marias River	251
LI-161	T29N	R5E	3	6.77	1,043	Marias River	450
LI-162	T29N	R5E	11	4.65	690	Marias River	298
LI-261	T29N	R6E	17	24.31	3,241	Marias River	1,614
LI-262	T29N	R7E	21	10.51	1,401	Marias River	697
LI-263	T29N	R7E	27	2.02	269	Marias River	134
							3,444
Lower Musselshell							
LM-20	T8N	R26E	18	90	8,150	Groundwater, Musselshell River	—
Meagher County							
MEI-11	T9N	R6E	6	10.87	1,247	Smith River	768
MEI-12	T10N	R5E	36	2.22	262	Smith River	166
MEI-20	T10N	R5E	4	2.56	303	Smith River	191
							1,125
Pondera County							
PO-91	T29N	R6W	17	0.99	117	Laughlin Coulee	52
PO-171	T30N	R6W	34	1.81	252	Birch Creek	130
PO-211	T28N	R5W	18	0.98	130	Dry Fork Marias River	58
PO-251	T28N	R10W	23	0.79	94	Birch Creek	42
PO-271	T30N	R4W	7	0.85	112	UT Bullhead Creek	50
PO-411	T30N	R4W	17	2.14	255	UT Bullhead Creek	113
PO-421	T31N	R6W	6	3.21	425	Two Medicine River	249
POI-10	T31N	R7W	5	5.28	707	Two Medicine River	364.3
							1,058.3
Teton County							
TE-81	T25N	R2W	11	0.16	21	Muddy Creek	9.0
TE-101	T26N	R4W	28	1.35	192	Muddy Creek	92.9
TE-181	T22N	R5W	35	3.11	443	Big Coulee	214.8
TE-183	T21N	R4W	5	9.51	1,353	Big Coulee	655.7
TE-281	T26N	R2E	34	0.86	107	Teton River	45.0
TE-282	T25N	R2E	2	1.72	208	Teton River	87.0
TE-321	T24N	R5W	3	6.51	926	Well-Teton River	449.0
TE-361	T24N	R3W	5	2.46	326	Spring Coulee	169.7
TE-401	T24N	R4W	14	2.67	380	UT Teton River, Teton River	184.2
TE-411	T25N	R1W	7	0.89	117	Teton River	49.0
TE-571	T23N	R1W	27	10.52	1,593	Muddy Creek, Sun River	711.0
TE-581	T24N	R4W	1	2.19	297	Gamble Coulee	139.4
TE-591	T24N	R4W	8	11.16	2,500	Gamble Coulee, Teton River	2,236.0
TEI-10	T25N	R2E	4	2.51	358	Teton River	173.3
TEI-20	T25N	R2E	7	1.72	238	Teton River	108.1
TEI-30	T24N	R4W	24	22.44	3,194	Teton River	1,547.8
TEI-40	T24N	R4W	5	0.89	126	Teton River	61.4
TEI-50	T25N	R5W	31	3.45	472	Teton River	229.1
TEI-60	T25N	R6W	31	10.99	1,505	Teton River	729.9
TEI-70	T25N	R7W	31	4.38	600	Teton River	290.4
TEI-80	T21N	R6W	26	1.62	250	Sun River	116.2
TEI-90	T22N	R8W	24	0.83	119	Sun River	55.4
TEI-100	T22N	R8E	32	1.21	173	Sun River	80.8
							8,435.0
Toole County							
TO-211	T30N	R1E	11	10.24	1,476	Tiber Reservoir	735
TO-221	T31N	R2W	28	1.26	153	Marias River	66
TO-341	T31N	R3E	25	3.39	488	Tiber Reservoir	243
TO-342	T31N	R3E	24	3.90	561	Tiber Reservoir	280
TO-421	T29N	R3E	12	0.81	112	Timber Coulee	48
							1,372
Valley County							
VAS-1	T26N	R40E	26	499.11	92,000	Fort Peck Reservoir	25,020

UT - Unnamed tributary

[a] Would supply supplemental water to existing irrigated lands

Sources: Big Sandy Conservation District 1989, Broadwater Conservation District 1987, Cascade County Conservation District 1989, Chouteau County Conservation District 1989, Fergus County Conservation District 1989, Gallatin Conservation District 1987, Glacier County Conservation District 1989, Hill County Conservation District 1989, Jefferson Valley Conservation District 1987, Judith Basin Conservation District 1989, Lewis and Clark County Conservation District 1989, Liberty County Conservation District 1989, Lower Musselshell Conservation District 1989, Meagher County Conservation District 1989, Pondera County Conservation District 1989, Teton County Conservation District 1989, Toole County Conservation District 1989, Valley County Conservation District 1989.

Map 1-1. Proposed conservation district projects in the Headwaters Subbasin


Jefferson Valley Conservation District
Broadwater Conservation District
Gallatin Conservation District
Boulder River
Big Hole River
Jefferson River
Ruby River
Beaverhead River
Red Rock River
Madison River
Gallatin River
E. Gallatin R.
Ennis Lake
Clark Canyon Reservoir
Lima Reservoir
Red Rock Lakes
Hebgen Lake
JV-17
JV-18
JV-63
JV-80
JV-81
JV-95
JV-202
JV-55
JV-203
JV-204
JV-25
JV-201
BR-101
BR-52
GA-102
GA-92
GA-81
GA-110
GA-130
GA-143
GA-151
GA-124
GA-79
GA-44
GA-24
GA-201
GA-40
GA-35
GA-41
GA-13
GA-46
GA-14
N
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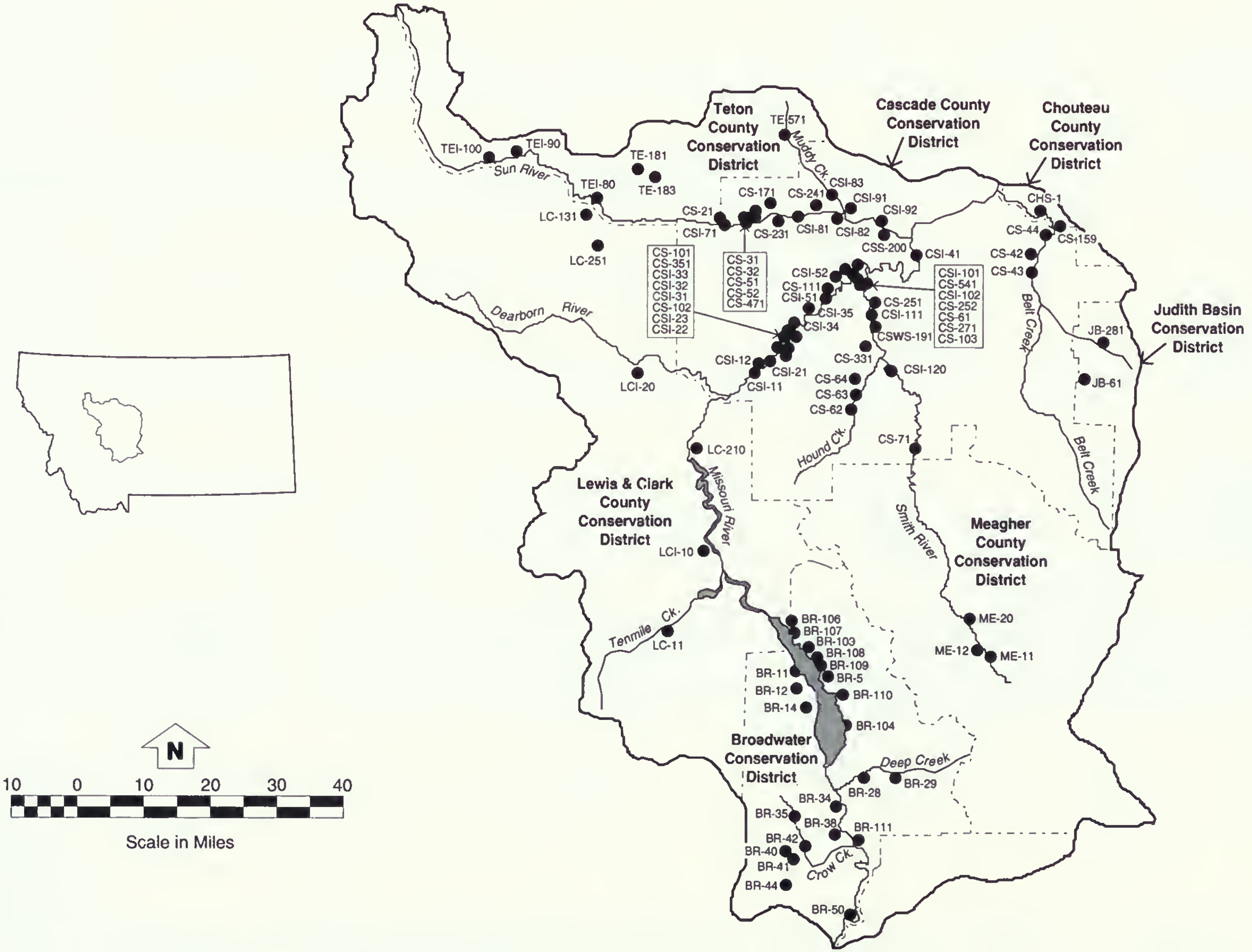
Scale in Miles

Map 1-2. Proposed conservation district projects in the Upper Missouri Subbasin


Teton
County
Conservation
District
Cascade County
Conservation
District
Chouteau
County
Conservation
District
Judith Basin
Conservation
District
Lewis & Clark
County
Conservation
District
Meagher
County
Conservation
District
Broadwater
Conservation
District
Sun River
Muddy Ck.
Dearborn River
Missouri River
Belt Creek
Hound Ck.
Smith River
Tenmile Ck.
Deep Creek
Crow Ck.
TEI-100
TEI-90
TE-181
TE-183
TE 571
TEI-80
LC-131
LC-251
LCI-20
LC-210
LCI-10
LC-11
CS-21
CSI-71
CS-171
CS-241
CSI-83
CSI-91
CSI-92
CS-231
CSI-81
CSI-82
CSS-200
CSI-41
CS-101
CS-351
CSI-33
CSI-32
CSI-31
CS-102
CSI-23
CSI-22
CS-31
CS-32
CS-51
CS-52
CS-471
CSI-52
CS-111
CSI-51
CSI-35
CSI-34
CSI-12
CSI-21
CSI-11
CS-251
CSI-111
CSWS-191
CSI-101
CS-541
CSI-102
CS-252
CS-61
CS-271
CS-103
CS-331
CSI-120
CS-64
CS-63
CS-62
CS-71
CHS-1
CS-44
CS-159
CS-42
CS-43
JB-281
JB-61
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ME-11
BR-106
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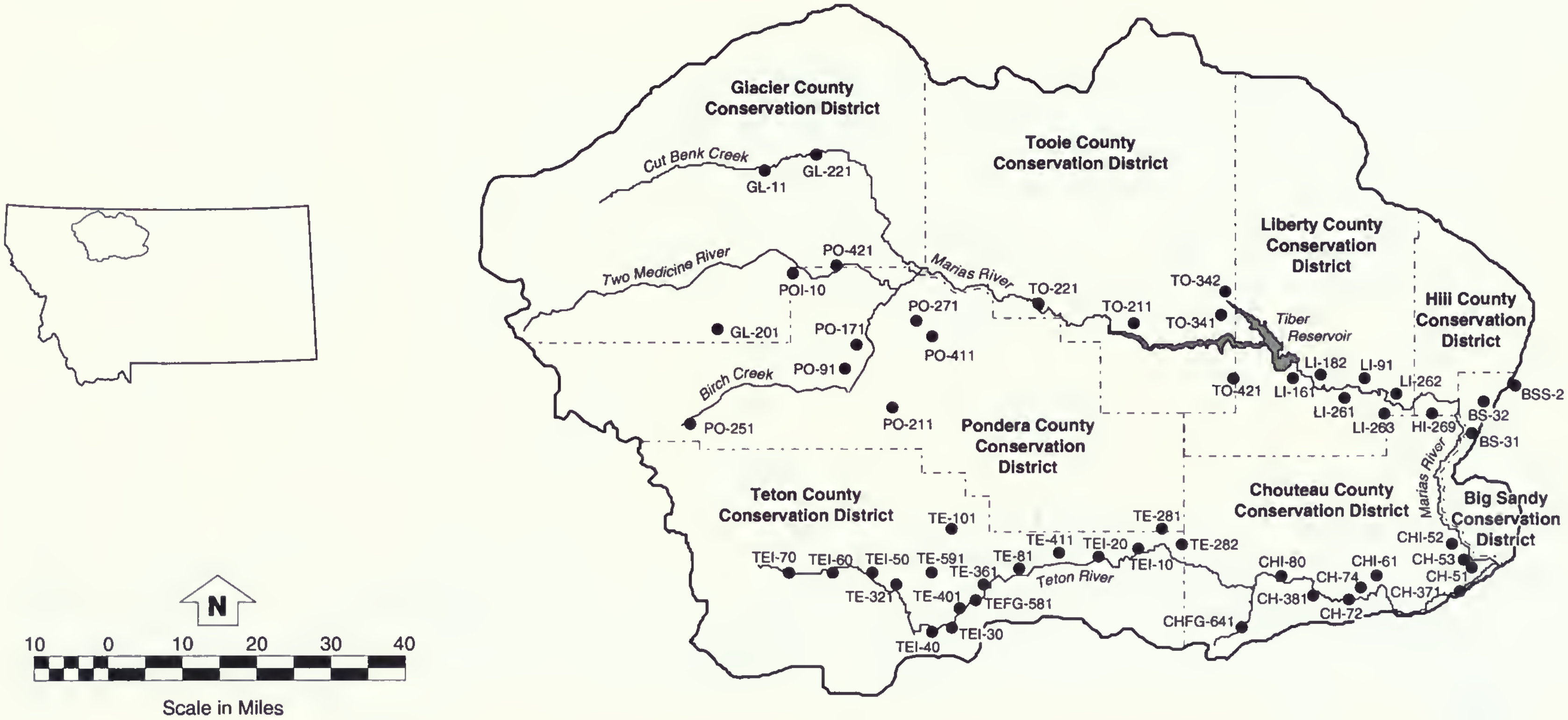
Scale in Miles

Map 1-3. Proposed conservation district projects in the Marias/Teton Subbasin


Glacier County Conservation District
Toole County Conservation District
Liberty County Conservation District
Hill County Conservation District
Pondera County Conservation District
Teton County Conservation District
Chouteau County Conservation District
Big Sandy Conservation District
Cut Benk Creek
Two Medicine River
Birch Creek
Marias River
Teton River
Tiber Reservoir
GL-11
GL-221
GL-201
PO-421
POI-10
PO-171
PO-91
PO-251
PO-271
PO-411
PO-211
TO-221
TO-211
TO-342
TO-341
TO-421
LI-182
LI-161
LI-91
LI-261
LI-262
LI-263
HI-269
BSS-2
BS-32
BS-31
TE-101
TE-281
TE-282
TE-411
TEI-20
TEI-10
TE-81
TE-361
TE-591
TEI-50
TEI-60
TEI-70
TE-321
TE-401
TEFG-581
TEI-30
TEI-40
CHFG-641
CHI-80
CH-381
CH-74
CH-72
CHI-61
CH-371
CHI-52
CH-53
CH-51
N
10
0
10
20
30
40
Scale in Miles

Map 1-4. Proposed conservation district projects in the Middle Missouri Subbasin

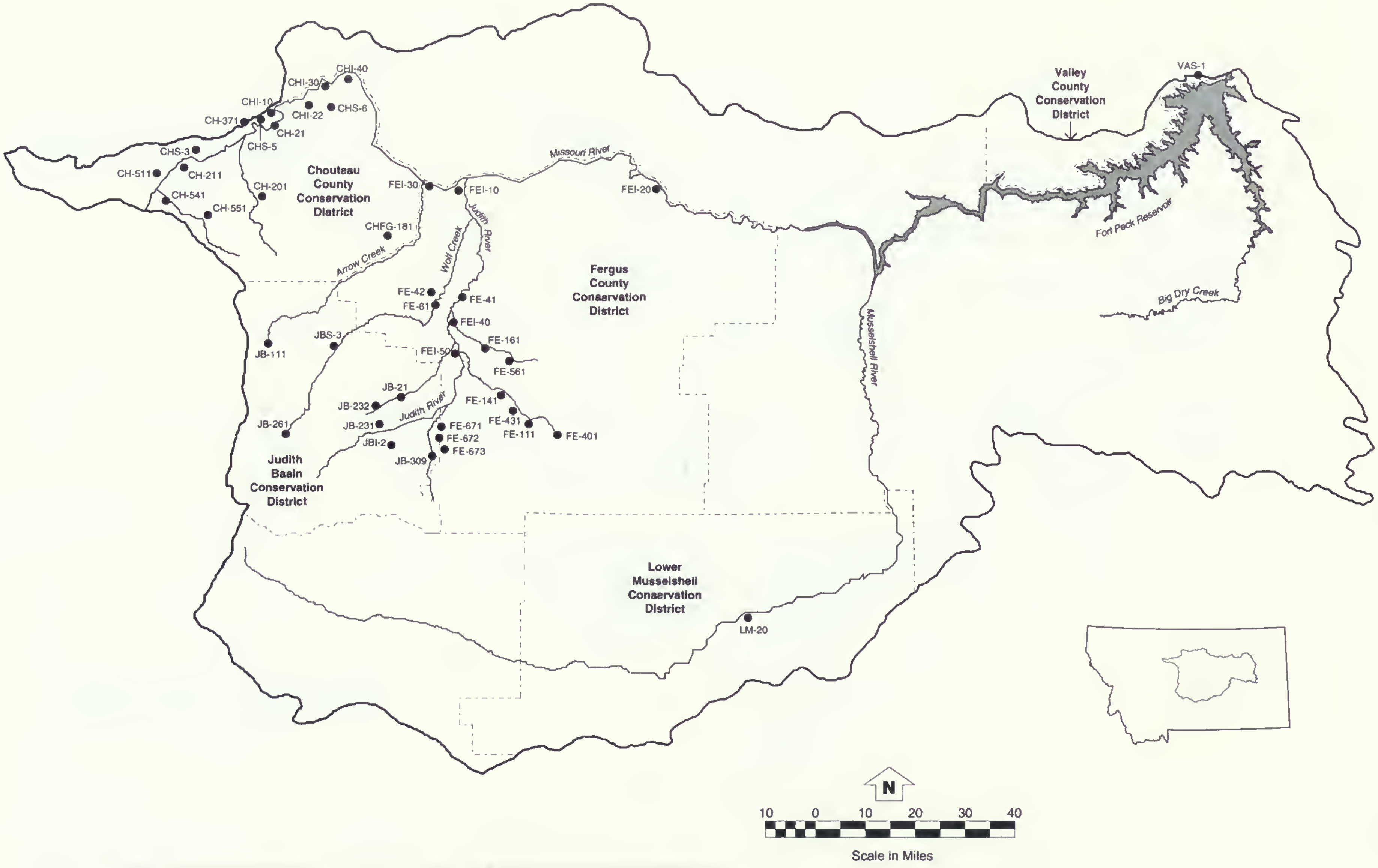

CHI-40
CHI-30
CHI-10
CHS-6
CHI-22
CH-371
CH-21
CHS-5
CHS-3
CH-511
CH-211
CH-201
CH-541
CH-551
Chouteau County Conservation District
FEI-30
FEI-10
CHFG-181
Arrow Creek
Wolf Creek
Judith River
Missouri River
FEI-20
Valley County Conservation District
VAS-1
Fort Peck Reservoir
Big Dry Creek
Musselshell River
Fergus County Conservation District
FE-42
FE-61
FE-41
FEI-40
FE-161
FE-561
FEI-50
JB-111
JBS-3
JB-21
JB-232
JB-231
JBI-2
JB-309
JB-261
FE-141
FE-431
FE-111
FE-401
FE-671
FE-672
FE-673
Judith Basin Conservation District
Lower Musselshell Conservation District
LM-20
N
10
0
10
20
30
40
Scale in Miles

Table 1-2. DFWP instream flow requests

HEADWATERS SUBBASIN

BIG HOLE RIVER DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED	
			(cfs)	(af/yr)
American Creek	Headwaters to mouth	Jan 1 - Dec 31	2.8	2,027
Bear Creek	Headwaters to mouth	Jan 1 - Dec 31	2.8	2,027
Big Hole River #1	Warm Springs Creek to Pintlar Creek	Jan 1 - Dec 31	160	115,835
Big Hole River #2	Pintlar Creek to the old Divide Dam	Jan 1 - Dec 31	800	579,173
Big Hole River #3	Old Divide Dam to mouth	Jan 1 - Dec 31	650	470,578
Big Lake Creek	Twin Lakes outlet to mouth	Jan 1 - Dec 31	4.7	3,403
Birch Creek	Mule Creek to mouth	Jan 1 - Dec 31	10	7,240
Bryant Creek	Headwaters to mouth	Jan 1 - Dec 31	1.4	1,014
California Creek	Headwaters to mouth	Jan 1 - Dec 31	14	10,136
Camp Creek	Headwaters to mouth	Jan 1 - Dec 31	5	3,620
Canyon Creek	Canyon Lake to mouth	Jan 1 - Dec 31	5	3,620
Corral Creek	Headwaters to mouth	Jan 1 - Dec 31	1	724
Deep Creek	Sevenmile and Tenmile to mouth	Jan 1 - Dec 31	18	13,031
Delano Creek	Headwaters to mouth	Jan 1 - Dec 31	0.3	217
Divide Creek	North and East forks to mouth	Jan 1 - Dec 31	3	2,172
Fishtrap Creek	West and Middle forks to mouth	Jan 1 - Dec 31	10	7,240
Francis Creek	Sand Creek to mouth	Jan 1 - Dec 31	4	2,896
French Creek	Headwaters to mouth	Jan 1 - Dec 31	6	4,344
Governor Creek	Headwaters to mouth	Jan 1 - Dec 31	4	2,896
Jacobsen Creek	Tahepia Lake to mouth	Jan 1 - Dec 31	14	10,136
Jerry Creek	Headwaters to mouth	Jan 1 - Dec 31	7	5,068
Johnson Creek	Schultz Creek to Forest Service boundary	Jan 1 - Dec 31	13	9,412
Joseph Creek	Anderson Creek to mouth	Jan 1 - Dec 31	5	3,620
LaMarche Creek	West and Middle forks to mouth	Jan 1 - Dec 31	11	7,964
Miner Creek	Upper Miner Lakes to mouth	Jan 1 - Dec 31	9	6,516
Moose Creek	Headwaters to mouth	Jan 1 - Dec 31	9	6,516
Mussigbrod Creek	Hell Roaring Creek to Forest Service boundary	Jan 1 - Dec 31	10	7,240
NF Big Hole River	Ruby and Trail creeks to mouth	Jan 1 - Dec 31	30	21,719
Oregon Creek	Headwaters to mouth	Jan 1 - Dec 31	0.3	217
Pattengail Creek	Sand Lake to mouth	Jan 1 - Dec 31	12	8,688
Pintlar Creek	Oreamnos Lake to mouth	Jan 1 - Dec 31	10	7,240
Rock Creek	Beaverhead National Forest boundary to mouth	Jan 1 - Dec 31	5	3,620
Ruby Creek	Pioneer and WF Ruby creeks to mouth	Jan 1 - Dec 31	4	2,896
Sevenmile Creek	Headwaters to mouth	Jan 1 - Dec 31	1.8	1,303
Seymour Creek	Upper Seymour Lake to mouth	Jan 1 - Dec 31	13	9,412
Sixmile Creek	Headwaters to mouth	Jan 1 - Dec 31	1.6	1,158
SF Big Hole River	Skinner Lake to mouth	Jan 1 - Dec 31	22	15,927
Steel Creek	Headwaters to mouth	Jan 1 - Dec 31	6	4,344
Sullivan Creek	Headwaters to mouth	Jan 1 - Dec 31	4	2,896
Swamp Creek	Yank Swamp to mouth	Jan 1 - Dec 31	8	5,792
Tenmile Creek	Tenmile Lakes to mouth	Jan 1 - Dec 31	3.8	2,751
Trail Creek	Headwaters to mouth	Jan 1 - Dec 31	14	10,136
Trapper Creek	Trapper Lake to mouth	Jan 1 - Dec 31	3.2	2,317
Twelvemile Creek	Headwaters to mouth	Jan 1 - Dec 31	1.2	869
Warm Springs Creek	West and East forks to mouth	Jan 1 - Dec 31	20	14,479
Willow Creek	Tendoy Lake to mouth	Jan 1 - Dec 31	16	11,583
Wise River	Mono and Jacobson creeks to mouth	Jan 1 - Dec 31	35	25,339
Wyman Creek	Headwaters to mouth	Jan 1 - Dec 31	7	5,068

GALLATIN RIVER DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED	
			(cfs)	(af/yr)
Baker Creek	Heeb Lane Bridge to mouth	Jan 1 - Dec 31	14	10,136
Ben Hart Creek	Headwaters to mouth	Jan 1 - Dec 31	29	20,995
Big Bear Creek	Headwaters to mouth	Jan 1 - Dec 31	2	1,448
Bridger Creek	Headwaters to mouth	Jan 1 - Dec 31	36.6	26,497
Cache Creek	Headwaters to mouth	Jan 1 - Dec 31	2.6	1,882
EF Hyalite Creek	Heather Lake to Hyalite Reservoir	Jan 1 - Dec 31	7	5,068
East Gallatin River #1	Rocky and Sourdough cks to Bozeman STP outlet	Jan 1 - Dec 31	121.3	87,817
East Gallatin River #2	Bozeman STP outlet to Thompson Spring Creek	Jan 1 - Dec 31	90	65,157
East Gallatin River #3	Thompson Spring Creek to mouth	Jan 1 - Dec 31	170	123,074

Ck - Creek EF - East Fork R - River SF - South Fork STP - sewage treatment plant WF - West Fork

Gallatin River Drainage (continued)

Gallatin River #1	Yellowstone NP boundary to WF Gallatin River	Jan 1 - Dec 31	170	123,074
Gallatin River #2	WF Gallatin River to East Gallatin River	Jan 1 - Dec 31	400	289,587
Gallatin River #3	East Gallatin River to mouth	Jan 1 - Dec 31	1,000	723,967
Hell Roaring Creek	NF Hell Roaring Creek to mouth	Jan 1 - Dec 31	16	11,583
Hyalite (Middle) Creek #1	Middle Creek Dam to Middle Creek Ditch intake	Jan 1 - Dec 31	28	20,271
Hyalite (Middle) Creek #2	I-90 bridge near Belgrade to mouth	Jan 1 - Dec 31	16	11,583
MF of the WF Gallatin R.	Headwaters to NF of the WF Gallatin River	Jan 1 - Dec 31	3	2,172
Porcupine Creek	NF Porcupine Creek to mouth	Jan 1 - Dec 31	4.5	3,258
Reese Creek	Bill Smith Creek to mouth	Jan 1 - Dec 31	5	3,620
Rocky Creek	Jackson Creek to Sourdough Creek	Jan 1 - Dec 31	51	36,922
Sourdough (Bozeman) Ck.	Mystic Reservoir to mouth	Jan 1 - Dec 31	35.9	25,990
South Cottonwood Creek	Jim Creek to Hart Ditch headgate	Jan 1 - Dec 31	14	10,136
SF Spanish Creek	Falls Creek to mouth	Jan 1 - Dec 31	15	10,859
SF of the WF Gallatin R.	Headwaters to mouth	Jan 1 - Dec 31	5	3,620
Spanish Creek	North and South forks to mouth	Jan 1 - Dec 31	70	50,678
Squaw Creek	Headwaters to mouth	Jan 1 - Dec 31	12	8,688
Taylor Fork	Tumbledown Creek to mouth of Gallatin River	Jan 1 - Dec 31	36	26,063
Thompson Spring Creek	County road crossing in T1N R5E Sec 30 to mouth	Jan 1 - Dec 31	29	20,995
WF Gallatin River	Middle and North forks to mouth	Jan 1 - Dec 31	26	18,823
WF Hyalite Creek	Hyalite Lake to Hyalite Reservoir	Jan 1 - Dec 31	12	8,688

JEFFERSON AND BOULDER RIVER DRAINAGES

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED (cfs)	(af/yr)
Boulder River #1	West and South forks to High Ore Creek	Jan 1 - Dec 31	20	14,479
Boulder River #2	High Ore Creek to Cold Spring	Jan 1 - Dec 31	24	17,375
Boulder River #3	Cold Spring to mouth	Jan 1 - Dec 31	47	34,026
Halfway Creek	Headwaters to canyon	Jan 1 - Dec 31	1.9	1,376
Hells Canyon Creek	Headwaters to mouth	Jan 1 - Dec 31	3.6	2,606
Jefferson River	Headwaters to Madison River	Jan 1 - Dec 31	1,100	796,363
Little Boulder River	Moose Creek to mouth	Jan 1 - Dec 31	7	5,068
North Willow Creek	Hollow Top Lake to mouth	Jan 1 - Dec 31	7	5,068
South Boulder River	Curly Creek to mouth	Jan 1 - Dec 31	12	8,688
South Willow Creek	Granite Lake to mouth	Jan 1 - Dec 31	14	10,136
Whitetail Creek	Whitetail Reservoir to mouth	Jan 1 - Dec 31	3	2,172
Willow Creek	North and South Willow creeks to mouth	Jan 1 - Dec 31	14	10,136
Willow Spring Creek	Headwaters to mouth	Jan 1 - Dec 31	9.2	6,660

MADISON RIVER DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED (cfs)	(af/yr)
Antelope Creek	Headwaters to mouth	Jan 1 - Dec 31	14	10,136
Beaver Creek	Wyethia Creek to Earthquake Lake	Jan 1 - Dec 31	937	42,280
Black Sand Spring Creek	Black Sand Spring to SF Madison River	Jan 1 - Dec 31	18.7	13,538
Blaine Spring Creek	Ennis National Fish Hatchery to mouth	Jan 1 - Dec 31	23	16,651
Cabin Creek	Gully Creek to Madison River	Jan 1 - Dec 31	585	28,741
Cherry Creek	Headwaters to mouth	Jan 1 - Dec 31	15	10,859
Cougar Creek	Yellowstone NP boundary to mouth	Jan 1 - Dec 31	24	17,375
Duck Creek	Yellowstone NP boundary to Hebgen Reservoir	Jan 1 - Dec 31	23	16,651
Elk River	Headwaters to mouth	Jan 1 - Dec 31	28	20,271
Grayling Creek	Yellowstone NP boundary to Hebgen Reservoir	Jan 1 - Dec 31	34	24,615
Hot Springs Creek	North and Middle forks to mouth	Jan 1 - Dec 31	5.5	3,982
Indian Creek	Raw Liver Creek to mouth	Jan 1 - Dec 31	48	34,750
Jack Creek	Lone Creek to mouth	Jan 1 - Dec 31	28	20,271
Madison River #1	Yellowstone NP boundary to Hebgen Reservoir	Jan 1 - Dec 31	500	361,983
Madison River #2	Hebgen Dam to West Fork	Jan 1 - Dec 31	800	579,173
Madison River #3	West Fork to Ennis Reservoir	Jan 1 - Dec 31	1,000	723,967
Madison River #4	Ennis Dam to mouth	Jan 1 - Dec 31	1,300	941,157
Moore Creek	Fletcher Creek to mouth	Jan 1 - Dec 31	1.4	1,014
North Meadow Creek	Headwaters to mouth	Jan 1 - Dec 31	18	13,031
O'Dell Creek	Headwaters to mouth	Jan 1 - Dec 31	98	70,949
Red Canyon Creek	Headwaters to Hebgen Reservoir	Jan 1 - Dec 31	2.9	2,100
Ruby Creek	Beartrap Canyon to mouth	Jan 1 - Dec 31	18	13,031
SF Madison River	Dry Canyon to Hebgen Reservoir	Jan 1 - Dec 31	92	66,605
Squaw Creek	North Fork to mouth	Jan 1 - Dec 31	14	10,136
Standard Creek	Headwaters to mouth	Jan 1 - Dec 31	10	7,240
Trapper Creek	Headwaters to Hebgen Reservoir	Jan 1 - Dec 31	3.2	2,317
Watkins Creek	Coffin Creek to Hebgen Reservoir	Jan 1 - Dec 31	5.5	3,982
WF Madison River	Fox Creek to mouth	Jan 1 - Dec 31	957	66,533

Ck - Creek   MF - Middle Fork   NF - North Fork   NP - National Park   R - River   SF - South Fork   WF - West Fork

RED ROCK-BEAVERHEAD DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED (cfs)	(af/yr)
Bear Creek	Headwaters to BLM boundary	Jan 1 - Dec 31	6.5	4,706
Beaverhead River #1	Clark Canyon to East Bench Div Dam at Barretts	Jan 1 - Dec 31	200	144,793
Beaverhead River #2	East Bench Diversion Dam at Barretts to mouth	Jan 1 - Dec 31	200	144,793
Big Sheep Creek	Cabin and Nicholia creeks to mouth	Jan 1 - Dec 31	48	34,750
Black Canyon Creek	Headwaters to mouth	Jan 1 - Dec 31	2.5	1,810
Blacktail Deer Creek	MF and WF to County Rd @ T8S R8W Secs 20 & 29	Jan 1 - Dec 31	42	30,407
Bloody Dick Creek	Swift Lake outlet to mouth	Jan 1 - Dec 31	20	14,479
Browns Canyon Creek	Headwaters to mouth	Jan 1 - Dec 31	2.3	1,665
Cabin Creek	Headwaters to mouth	Jan 1 - Dec 31	0.4	290
Corral Creek	Headwaters to mouth	Jan 1 - Dec 31	6	4,344
Deadman Creek	Deadman Lake to mouth	Jan 1 - Dec 31	4.5	3,258
EF Blacktail Deer Creek	Headwaters to mouth	Jan 1 - Dec 31	18	13,031
EF Clover Creek	Headwaters to mouth	Jan 1 - Dec 31	4.4	3,185
EF Dyce Creek	Headwaters to mouth	Jan 1 - Dec 31	1.4	1,014
Frying Pan Creek	Headwaters to mouth	Jan 1 - Dec 31	1.6	1,158
Grasshopper Creek	Blue Creek to mouth	Jan 1 - Dec 31	30	21,719
Hell Roaring Creek	Headwaters to mouth	Jan 1 - Dec 31	15	10,859
Horse Prairie Creek	Headwaters to mouth	Jan 1 - Dec 31	36	26,063
Indian Creek	Headwaters to mouth	Jan 1 - Dec 31	0.2	145
Jones Creek	Headwaters to Lakeview Road crossing	Jan 1 - Dec 31	1.9	1,376
Long Creek	Jones Creek to mouth	Jan 1 - Dec 31	3.4	2,461
Medicine Lodge Creek	Bear Canyon to mouth	Jan 1 - Dec 31	10	7,240
Narrows Creek	Spring in T13S R1E Sec18A to Elk Lake	May 1 - July 15	1.2	869
		July 16 - April 30	0.5	362
Odell Creek	Headwaters to Lower Red Rock Lake	Jan 1 - Dec 31	11	7,964
Peet Creek	Headwaters to reservoir in T14S R4W Sec34A	Jan 1 - Dec 31	0.9	652
Poindexter Slough	Springs & canal T8S R9W Sec3,SW to Beaverhead	Jan 1 - Dec 31	57.9	41,918
Rape Creek	Headwaters to reservoir in T10S R13W Sec4	Jan 1 - Dec 31	0.4	290
Red Rock Creek	Headwaters to Upper Red Rock Lake	Jan 1 - Dec 31	15	10,859
Red Rock River #1	Dam at Lower Red Rock Lake to Lima Reservoir	Jan 1 - Dec 31	55	39,818
Red Rock River #2	Lima Dam to Clark Canyon Reservoir	Jan 1 - Dec 31	60	43,438
Reservoir Creek	Headwaters to mouth	Jan 1 - Dec 31	1.5	1,086
Shenon Creek	Headwaters to BLM boundary in T10S R14W Sec25	Jan 1 - Dec 31	0.4	290
Simpson Creek	Headwaters to mouth	Jan 1 - Dec 31	0.7	507
Tom Creek	Headwaters to Upper Red Rock Lake	Jan 1 - Dec 31	1.4	1,014
Trapper Creek	Headwaters to mouth	Jan 1 - Dec 31	0.7	507
WF Blacktail Deer Creek	Grays and South forks to mouth	Jan 1 - Dec 31	3	2,172
WF Dyce Creek	Headwaters to mouth	Jan 1 - Dec 31	0.7	507

RUBY RIVER DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED (cfs)	(af/yr)
Coal Creek	Headwaters to mouth	Jan 1 - Dec 31	3.6	2,606
Cottonwood Creek	Geyser Creek to mouth	Jan 1 - Dec 31	4	2,896
EF Ruby River	Headwaters to mouth	Jan 1 - Dec 31	3	2,172
MF Ruby River	Divide Creek to mouth	Jan 1 - Dec 31	5	3,620
Mill Creek	Outlet of Branham Lake to mouth	Jan 1 - Dec 31	10	7,240
NF Greenhorn Creek	Headwaters to mouth	Jan 1 - Dec 31	3.5	2,534
Ruby River #1	East, Middle, and West forks to Ruby Reservoir	Jan 1 - Dec 31	102	73,845
Ruby River #2	Ruby Dam to mouth	Jan 1 - Dec 31	40	28,959
Warm Springs Creek	Ruby Lake outlet to mouth	Jan 1 - Dec 31	48.5	35,112
WF Ruby River	Headwaters to mouth	Jan 1 - Dec 31	3.0	2,172
Wisconsin Creek	Crystal Lake outlet to mouth	Jan 1 - Dec 31	12	8,688

UPPER MISSOURI SUBBASIN

UPPER MISSOURI RIVER AND TRIBUTARIES

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED (cfs)	(af/yr)
Avalanche Creek	Cooney Gulch to Canyon Ferry Reservoir	Jan 1 - Dec 31	5	3,620
Beaver Creek	Headwaters in Elkhorn Mts to Canyon Ferry Reservoir	Jan 1 - Dec 31	2.8	2,027
Beaver Creek	Headwaters in Big Belt Mts to mouth	Jan 1 - Dec 31	10.0	7,240
Canyon Creek	Headwaters to mouth	Jan 1 - Dec 31	10.0	7,240
Confederate Gulch	Debauch Gulch to mouth	Jan 1 - Dec 31	5	3,620
Cottonwood Creek	Headwaters to mouth	Jan 1 - Dec 31	1.0	724
Crow Creek	Tizer and Wilson Creeks to Williams Ditch intake	Jan 1 - Dec 31	11	7,964
Deep Creek	Castle Fork to Missouri River	Jan 1 - Dec 31	9	6,516

EF - East Fork MF - Middle Fork NF - North Fork WF - West Fork

Upper Missouri River and Tributaries (continued)

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED		
			(cfs)	(af)	(af/yr)
Dry Creek	Headwaters to Broadwater Missouri Canal	Jan 1 - Dec 31	1.8	1,303	
Duck Creek	Headwaters to Canyon Ferry Res.	Jan 1 - Dec 31	8	5,792	
Little Prickly Pear Ck. #1	Canyon Creek to Clark Creek	Jan 1 - Dec 31	22	15,927	15,927
Little Prickly Pear Ck. #2	Clark Creek to mouth	Jan 1 - Dec 31	70	50,678	50,678
Lyons Creek	Headwaters to mouth	Jan 1 - Dec 31	10.0	7,240	7,240
McGuire Creek	Headwaters to mouth	May 1 - Nov 30	8.3	3,523	
		Dec 1 - Apr 30	4.7	1,408	4,931
Missouri River #1	Jefferson and Madison rivers to Canyon Ferry Res.	Jan 1 - Dec 31	2,400	1,737,520	1,737,520
Missouri River #2	Hauser Dam to Holter Reservoir	Oct 15 - Dec 15	4,878	599,873	
		Dec 16 - Mar 15	3,000	535,537	
		Mar 16 - Apr 30	5,316	485,030	
		May 1 - June 30	7,890	954,624	
		July 1 - Oct 14	3,500	735,867	3,310,931
Missouri River #3	Holter Dam to Great Falls	May 19 - July 5	6,398	609,132	
		July 6 - May 18	4,100	2,577,916	3,187,048
Prickly Pear Creek #1	Rabbit Gulch to Hwy 12 bridge in East Helena	Jan 1 - Dec 31	22	15,927	15,927
Prickly Pear Creek #2	Hwy 12 bridge in East Helena to Lake Helena	Jan 1 - Dec 31	30	21,719	21,719
Sevenmile Creek	Greenhorn Creek and Skelly Gulch to mouth	Jan 1 - Dec 31	1.0	724	724
Sheep Creek	Headwaters of South Fork to mouth	Jan 1 - Dec 31	22	15,927	15,927
Silver Creek	Helena Valley Irrigation Canal to mouth	May 1 - Nov 30	13.0	5,518	
		Dec 1 - Apr 30	5.4	1,617	7,135
Sixteenmile Creek	Billy Creek to mouth	Jan 1 - Dec 31	20	14,479	14,479
Spokane Creek	Helena Valley Irr. Canal to mouth	May 1 - Nov 30	4.0	1,698	
		Dec 1 - Apr 30	3.0	898	2,596
Stickney Creek	North and South forks to mouth	Apr 1 - Apr 30	7	417	
		May 1 - May 31	34	2,091	
		June 1 - June 30	35	2,083	
		July 1 - July 31	7	430	5,021
Tenmile Creek	Headwaters to mouth	Jan 1 - Dec 31	12.0	8,688	8,688
Trout Creek	Springs near Vigilante Campground to mouth	Jan 1 - Dec 31	15.0	10,860	10,860
Virginia Creek	Headwaters to mouth	Jan 1 - Dec 31	6.0	4,344	4,344
Wegner Creek	Headwaters to mouth	Apr 1 - Apr 30	8	476	
		May 1 - May 31	41	2,521	
		June 1 - June 30	38	2,261	
		July 1 - July 31	8	492	5,750
Willow Creek	Headwaters to mouth	Jan 1 - Dec 31	3.5	2,534	2,534
Wolf Creek	Headwaters to mouth	Jan 1 - Dec 31	7.0	5,068	5,068

DEARBORN RIVER DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED		
			(cfs)	(af)	(af/yr)
Dearborn River	Headwaters to mouth	Jan 1 - Dec 31	110	79,636	79,636
Flat Creek	Headwaters to mouth	Jan 1 - Dec 31	7.5	5,430	5,430
MF Dearborn River	Headwaters to mouth	Jan 1 - Dec 31	9.5	6,878	6,878
SF Dearborn River	Headwaters to mouth	Jan 1 - Dec 31	11.5	8,326	8,326

SMITH RIVER DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED		
			(cfs)	(af)	(af/yr)
Big Birch Creek	Headwaters to mouth	Jan 1 - Dec 31	11	7,964	7,964
Eagle Creek	Headwaters to mouth	Jan 1 - Dec 31	2.5	1,810	1,810
Hound Creek	EF Hound Creek and Middle Creek to mouth	Jan 1 - Dec 31	35	25,339	25,339
Newlan Creek	Headwaters to mouth	Jan 1 - Dec 31	3.8	2,751	2,751
NF Deep Creek	Headwaters to rock cascades	Jan 1 - Dec 31	1.0	724	724
NF Smith River	Headwaters to mouth	Jan 1 - Dec 31	9	6,516	6,516
Rock Creek	Headwaters to mouth	Jan 1 - Dec 31	11	7,964	7,964
Sheep Creek	Headwaters to mouth	Jan 1 - Dec 31	35	25,339	25,339
Smith River #1	North and South Forks to Sheep Creek	Jan 1 - Dec 31	90	65,157	65,157

EF - East Fork   Irr. - Irrigation   MF - Middle Fork   Res. - Reservoir   SF - South Fork

Smith River Drainage (continued)

Smith River #2	Sheep Creek to Hound Creek	Jan 1 - Dec 31	150	108,595	108,595
Smith River #3	Hound Creek to mouth	Jan 1 - Dec 31	80	57,917	57,917
SF Smith River	Headwaters to mouth	Jan 1 - Dec 31	7	5,068	5,068
Tenderfoot Creek	Headwaters to mouth	Jan 1 - Dec 31	15	10,859	10,859

SUN RIVER DRAINAGE

		DATES	AMOUNT REQUESTED		
STREAM	REACH DESCRIPTION	REQUESTED	(cfs)	(af)	(af/yr)
Elk Creek	Headwaters to mouth	Jan 1 - Dec 31	16	11,583	11,583
Ford Creek	Headwaters to mouth	Jan 1 - Dec 31	12	8,688	8,688
NF Willow Creek	Headwaters to mouth	Jan 1 - Dec 31	3.0	2,172	2,172
Sun River #1	Diversion Dam to Elk Creek	Jan 1 - Dec 31	100	72,397	72,397
Sun River #2	Elk Creek to mouth	Jan 1 - Dec 31	130	94,116	94,116
Willow Creek	Headwaters to mouth	Jan 1 - Dec 31	3	2,172	2,172

BELT CREEK DRAINAGE

		DATES	AMOUNT REQUESTED		
STREAM	REACH DESCRIPTION	REQUESTED	(cfs)	(af)	(af/yr)
Belt Creek #1	Headwaters to Big Otter Creek	Jan 1 - Dec 31	90	65,157	65,157
Belt Creek #2	Big Otter Creek to Missouri River	Jan 1 - Dec 31	35	25,339	25,339
Big Otter Creek	Whiskey Spring Coulee to Belt Creek	Jan 1 - Dec 31	5	3,620	3,620
Dry Fork Belt Creek	Galena and Oti Park Creek to Belt Creek	Jan 1 - Dec 31	7	5,068	5,068
Logging Creek	Headwaters to Belt Creek	Jan 1 - Dec 31	6	4,344	4,344
Pilgrim Creek	Headwaters to Belt Creek	Jan 1 - Dec 31	8	5,792	5,792
Tillinghast Creek	Headwaters to Belt Creek	Jan 1 - Dec 31	5.5	3,982	3,982

MIDDLE MISSOURI SUBBASIN

MIDDLE MISSOURI RIVER AND TRIBUTARIES

		DATES	AMOUNT REQUESTED		
STREAM	REACH DESCRIPTION	REQUESTED	(cfs)	(af)	(af/yr)
Cow Creek	NF and SF to County bridge	Jan 1 - Dec 31	4.5	3,258	3,258
Highwood Creek	Headwaters to Hwy 228 Bridge at Highwood	Jan 1 - Dec 31	10	7,240	7,240
Missouri River #4	Great Falls to Maris River	Mar 15 - May 18	4,887	630,059	
		May 19 - July 5	11,284	1,074,311	
		July 6 - Aug 31	4,500	508,760	
		Sep 1 - Mar 14	3,700	1,431,075	3,644,205
Missouri River #5	Marias River to Judith River	Mar 15 - May 18	5,571	718,244	
		May 19 - July 5	14,000	1,332,892	
		July 6 - Aug 31	5,400	610,512	
		Sep 1 - Mar 14	4,300	1,663,140	4,324,788
Missouri River #6	Judith River to upper end of Fort Peck Reservoir	Mar 15 - May 18	7,100	915,371	
		May 19 - July 5	15,302	1,456,851	
		July 6 - Aug 31	5,800	655,735	
		Sep 1 - Mar 14	4,700	1,817,850	4,845,807
Shonkin Creek	Forest boundary to town of Shonkin	Jan 1 - Dec 31	7	5,068	5,068

FORT PECK RESERVOIR TRIBUTARIES

Big Dry Creek	Hwy 200 bridge to mouth	Mar 15 - Mar 31	300	9,521	
		Apr 1 - Apr 30	100	5,950	
		May 1 - May 31	35	2,152	
		June 1 - Oct 31	5.5	1,669	19,292
Little Dry Creek	Whiteside ranch house to Big Dry Creek	Mar 15 - Mar 31	110	3,491	
		Apr 1 - Apr 30	42	2,499	
		May 1 - May 31	17	1,045	
		June 1 - Oct 31	3.5	1,062	8,097

JUDITH RIVER DRAINAGE

		DATES	AMOUNT REQUESTED		
STREAM	REACH DESCRIPTION	REQUESTED	(cfs)	(af)	(af/yr)
Beaver Creek	West Fork to Cottonwood Creek	Jan 1 - Dec 31	5	3,620	3,620
Big Spring Creek #1	Fish hatchery to Cottonwood Creek	Jan 1 - Dec 31	110	79,636	79,636
Big Spring Creek #2	Cottonwood Creek to mouth	Jan 1 - Dec 31	100	72,397	72,397
Cottonwood Creek	Spring Branch of Cottonwood Ck. to Big Spring Ck.	Jan 1 - Dec 31	4.5	3,258	3,258

Hwy - Highway NF - North Fork SF - South Fork

Judith River Drainage (continued)

East Fork Big Spring Ck.	Headwaters to Big Spring Creek	Jan 1 - Dec 31	7.5	5,430	5,430
Judith River #1	SF and MF to Big Spring Creek	Jan 1 - Dec 31	25	18,099	18,099
Judith River #2	Big Spring Creek to Missouri River	Jan 1 - Dec 31	160	115,835	115,835
Lost Fork Judith River	SF and WF to MF Judith River	Jan 1 - Dec 31	14	10,136	10,136
Middle Fork Judith River	Headwaters to South Fork	Jan 1 - Dec 31	22	15,928	15,928
South Fork Judith River	Headwaters to Middle Fork	Jan 1 - Dec 31	3.5	2,534	2,534
Warm Spring Creek	Springs to Judith River	Jan 1 - Dec 31	110	79,636	79,636
Yogo Creek	Headwaters to MF Judith River	Jan 1 - Dec 31	3	2,172	2,172

MUSSELSHELL RIVER DRAINAGE

		DATES	AMOUNT REQUESTED		
STREAM	REACH DESCRIPTION	REQUESTED	(cfs)	(af)	(af/yr)
Alabaugh Creek	Headwaters to mouth	Jan 1 - Dec 31	12	8,688	8,688
American Fork	South Fork to mouth	Jan 1 - Dec 31	5.5	3,982	3,982
Big Elk Creek	Origin of Lebo Fork to mouth	Jan 1 - Dec 31	9.5	6,878	6,878
Careless Creek	Headwaters to Roberts Creek	Jan 1 - Dec 31	2	1,448	1,448
Checkerboard Creek	East and West Forks to mouth	Jan 1 - Dec 31	6	4,344	4,344
Collar Gulch Creek	Headwaters to mouth	Jan 1 - Dec 31	0.6	434	434
Cottonwood Creek	WF, MF, and Loco Creek to mouth	Jan 1 - Dec 31	16	11,583	11,583
Flatwillow Creek	NF and SF to Petrolia Reservoir	Jan 1 - Dec 31	18	13,031	13,031
Musselshell River #1	NF and SF to Deadmans Basin Div	Jan 1 - Dec 31	80	57,917	57,917
Musselshell River #2	Deadmans Basin Div to Musselshell Div	Jan 1 - Dec 31	80	57,917	57,917
Musselshell River #3	Musselshell Diversion Dam at town of Musselshell to mouth	Jan 1 - Dec 31	70	50,678	50,678
NF Musselshell #1	Headwaters to Bair Reservoir	Jan 1 - Dec 31	3	2,172	2,172
NF Musselshell #2	Bair Reservoir to SF Musselshell R.	Jan 1 - Dec 31	16	11,583	11,583
SF Musselshell	Headwaters to North Fork	Jan 1 - Dec 31	30	21,719	21,719
Spring Creek	Headwaters to mouth	Jan 1 - Dec 31	8	5,792	5,792
Swimming Woman Ck.	Headwaters to Cty road crossing 8 linear miles upstream from mouth	Jan 1 - Dec 31	2.5	1,810	1,810

MARIAS/TETON SUBBASIN

MARIAS RIVER DRAINAGE

		DATES	AMOUNT REQUESTED		
STREAM	REACH DESCRIPTION	REQUESTED	(cfs)	(af)	(af/yr)
Badger Creek	N and S Badger creeks to Forest/ Blackfeet Reservation Boundary	Jan 1 - Dec 31	60	43,438	43,438
Birch Creek	Swift Reservoir to Hwy 358	Jan 1 - Dec 31	64	46,334	46,334
Cut Bank Creek	Blackfeet Reservation boundary to mouth	Jan 1 - Dec 31	75	54,297	54,297
Dupuyer Creek	Headwaters to mouth	Jan 1 - Dec 31	12	8,688	8,688
Marias River #1	Two Medicine River and Cut Bank Creek to head of Tiber Reservoir	Jan 1 - Dec 31	200	144,793	144,793
Marias River #2	Tiber Dam to Circle Bridge (Hwy 223)	Jan 1 - Dec 31	500	361,983	361,983
Marias River #3	Circle Bridge (Hwy 223) to mouth	Jan 1 - Dec 31	560	405,421	405,421
North Badger Creek	Headwaters to mouth	Jan 1 - Dec 31	14	10,136	10,136
NF Dupuyer Creek	Headwaters to mouth	Jan 1 - Dec 31	12	8,688	8,688
South Badger Creek	Headwaters to mouth	Jan 1 - Dec 31	40	28,959	28,959
SF Dupuyer Creek	Headwaters to mouth	Jan 1 - Dec 31	6	4,344	4,344
SF Two Medicine River	Headwaters to Forest/ Blackfeet Reservation Boundary	Jan 1 - Dec 31	16	11,583	11,583

TETON RIVER DRAINAGE

		DATES	AMOUNT REQUESTED		
STREAM	REACH DESCRIPTION	REQUESTED	(cfs)	(af)	(af/yr)
Deep Creek	Headwaters to mouth	Jan 1 - Dec 31	18	13,031	13,031
McDonald Creek	Headwaters to mouth	Jan 1 - Dec 31	10	7,240	7,240
NF Deep Creek	Headwaters to mouth	Jan 1 - Dec 31	7.2	5,212	5,212
SF Deep Creek	Headwaters to mouth	Jan 1 - Dec 31	6.9	4,995	4,995
Spring Creek	Headwaters to mouth	Jan 1 - Dec 31	4.5	3,258	3,258
Teton River	Headwaters to discharge from Priest Butte Lake	Jan 1 - Dec 31	35	25,339	25,339

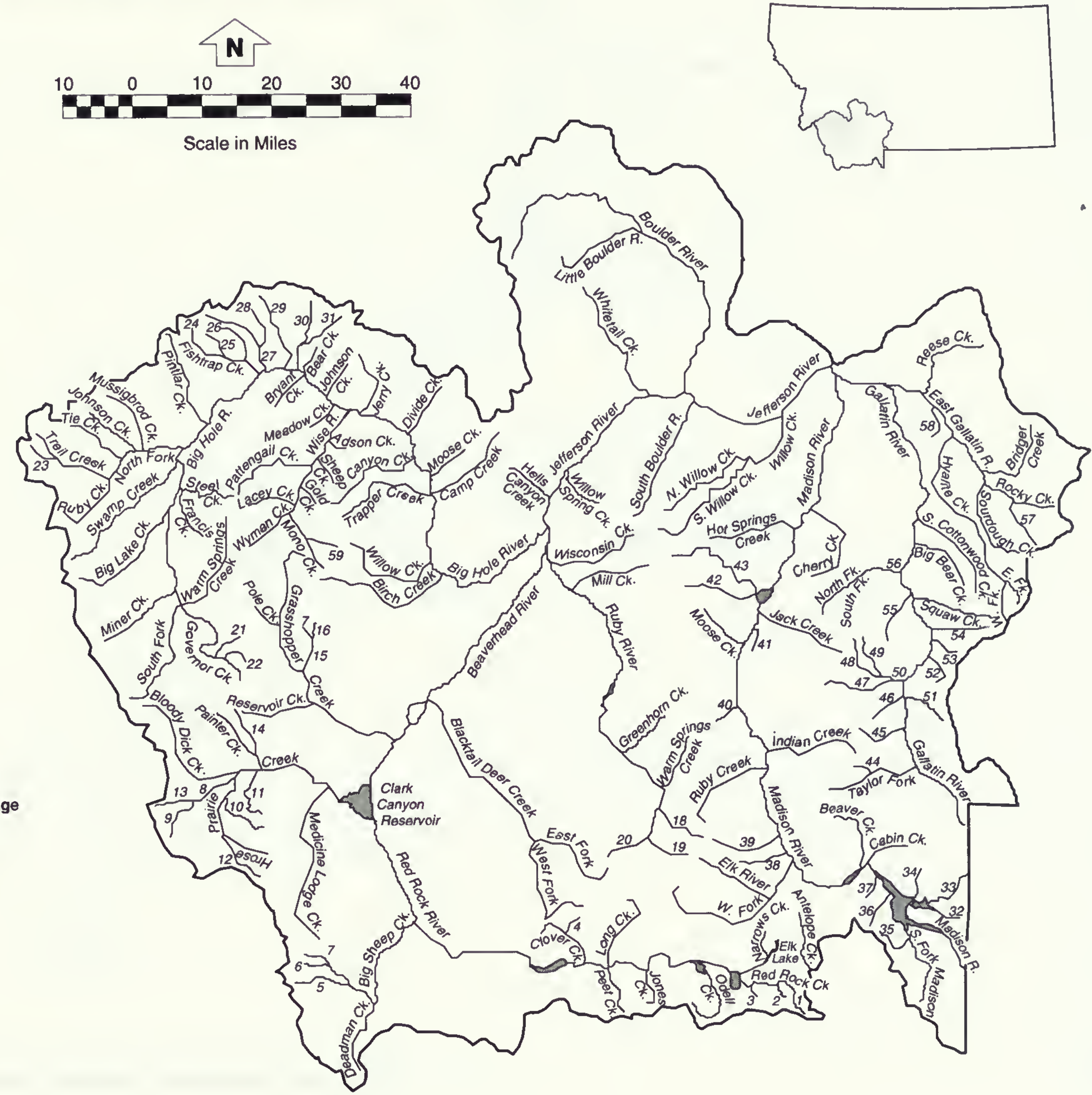
LAKES AND SWAMPS

Bean Lake	Sec. 18C and 19B, T18N, R6W, Sec. 13D and 24A, T18N, R7W	Jan 1 - Dec 31	—	2,649	2,649
Antelope Butte Swamp	North $^{1}/_{2}$ Sec. 28, T26N, R8W	Jan 1 - Dec 31	—	460	460

Ck. - Creek Cty - County Div - Diversion Hwy - Highway MF - Middle Fork NF - North Fork R - River SF - South Fork WF - West Fork

Source: DFWP 1989

Map 1-5. Streams where instream flows have been requested in the Headwaters Subbasin


N
10
0
10
20
30
40
Scale in Miles
Boulder River
Little Boulder R.
Whitetail Ck.
Jefferson River
Gallatin River
Reese Ck.
East Gallatin R.
58
Bridger Creek
Hyalite Ck.
Rocky Ck.
Sourdough Ck.
57
S. Cottonwood Ck.
E. Fk.
Big Bear Ck.
Squaw Ck.
M. Fk.
56
Madison River
Willow Ck.
N. Willow Ck.
S. Willow Ck.
Hot Springs Creek
South Boulder R.
Willow Spring Ck.
Hells Canyon Creek
Wisconsin Ck.
Mill Ck.
Ruby River
Cherry Ck.
North Fk.
South Fk.
Jack Creek
Moose Ck.
41
42
43
55
49
48
50
47
52
53
54
46
51
45
44
Indian Creek
Gallatin River
Taylor Fork
Beaver Ck.
Cabin Ck.
Madison R.
S. Fork Madison
32
33
34
35
36
37
Greenhorn Ck.
Warm Springs Creek
40
Ruby Creek
Madison River
39
38
Elk River
W. Fork
Narrows Ck.
Antelope Ck.
Elk Lake
Red Rock Ck
1
2
3
Odell Ck.
Jones Ck.
Peet Ck.
Long Ck.
Clover Ck.
4
18
19
20
East Fork
West Fork
Blacktail Deer Creek
Beaverhead River
Big Hole River
Clark Canyon Reservoir
Red Rock River
Big Sheep Ck.
Deadman Ck.
Medicine Lodge Ck.
7
6
5
Mussigbrod Ck.
Johnson Ck.
Tie Ck.
Trail Creek
23
Ruby Ck.
Swamp Creek
North Fork
Big Hole R.
Pintlar Ck.
Fishtrap Ck.
24
25
26
27
28
29
30
31
Bryant Ck.
Bear Ck.
Johnson Ck.
Jerry Ck.
Divide Ck.
Meadow Ck.
Wise R.
Adson Ck.
Sheep Ck.
Canyon Ck.
Gold Ck.
Moose Ck.
Camp Creek
Trapper Creek
Pattengail Ck.
Steel Ck.
Lacey Ck.
Wyman Ck.
Mono Ck.
59
Willow Ck.
Birch Creek
Francis Ck.
Big Lake Ck.
Warm Springs Creek
Pole Ck.
Grasshopper Creek
16
15
21
22
Governor Ck.
Miner Ck.
South Fork
Bloody Dick Ck.
Painter Ck.
Reservoir Ck.
14
11
10
13
8
9
Prairie
Horse
12

KEY TO NUMBERED STREAMS

1) Hell Roaring Creek
2) Corral Creek
3) Tom Creek
4) East Fork Clover Creek
5) Simpson Creek
6) Indian Creek
7) Cabin Creek
8) Trail Creek
9) Bear Creek
10) Shenon Creek
11) Rape Creek
12) Black Canyon Creek
13) Frying Pan Creek
14) Browns Canyon Creek
15) Dyce Creek
16) East Fork Dyce Creek
17) West Fork Dyce Creek
18) Cottonwood Creek
19) Coal Creek
20) Middle Fork
21) Fox Creek
22) Andrus Creek
23) Joseph Creek
24) West Fork Fishtrap Creek
25) Middle Fork Fishtrap Creek
26) East Fork Fishtrap Creek
27) LaMarche Creek
28) Middle Fork LaMarche Creek
29) Seymore Creek
30) Deep Creek
31) French Creek
32) Cougar Creek
33) Grayling Creek
34) Red Canyon Creek
35) West Fork Denny Creek
36) Watkins Creek
37) Trapper Creek
38) Soap Creek
39) Standard Creek
40) Blaine Spring Creek
41) O'Dell Creek
42) South Meadow Creek
43) North Meadow Creek
44) Cache Creek
45) Buck Creek
46) Beaver Creek
47) South Fork West Fork Gallatin River
48) Middle Fork West Fork Gallatin River
49) North Fork West Fork Gallatin River
50) West Fork Gallatin River
51) Porcupine Creek
52) Portal Creek
53) Moose Creek
54) Swan Creek
55) Hell Roaring Creek
56) Spanish Creek
57) Bear Canyon Creek
58) Thompson Creek
59) Jacobson Creek

STREAMS NOT SHOWN

Big Hole Drainage
Sullivan Creek
Twelvemile Creek
Corral Creek
Tenmile Creek
Sevenmile Creek
Sixmile Creek
Oregon Creek
California Creek
American Creek

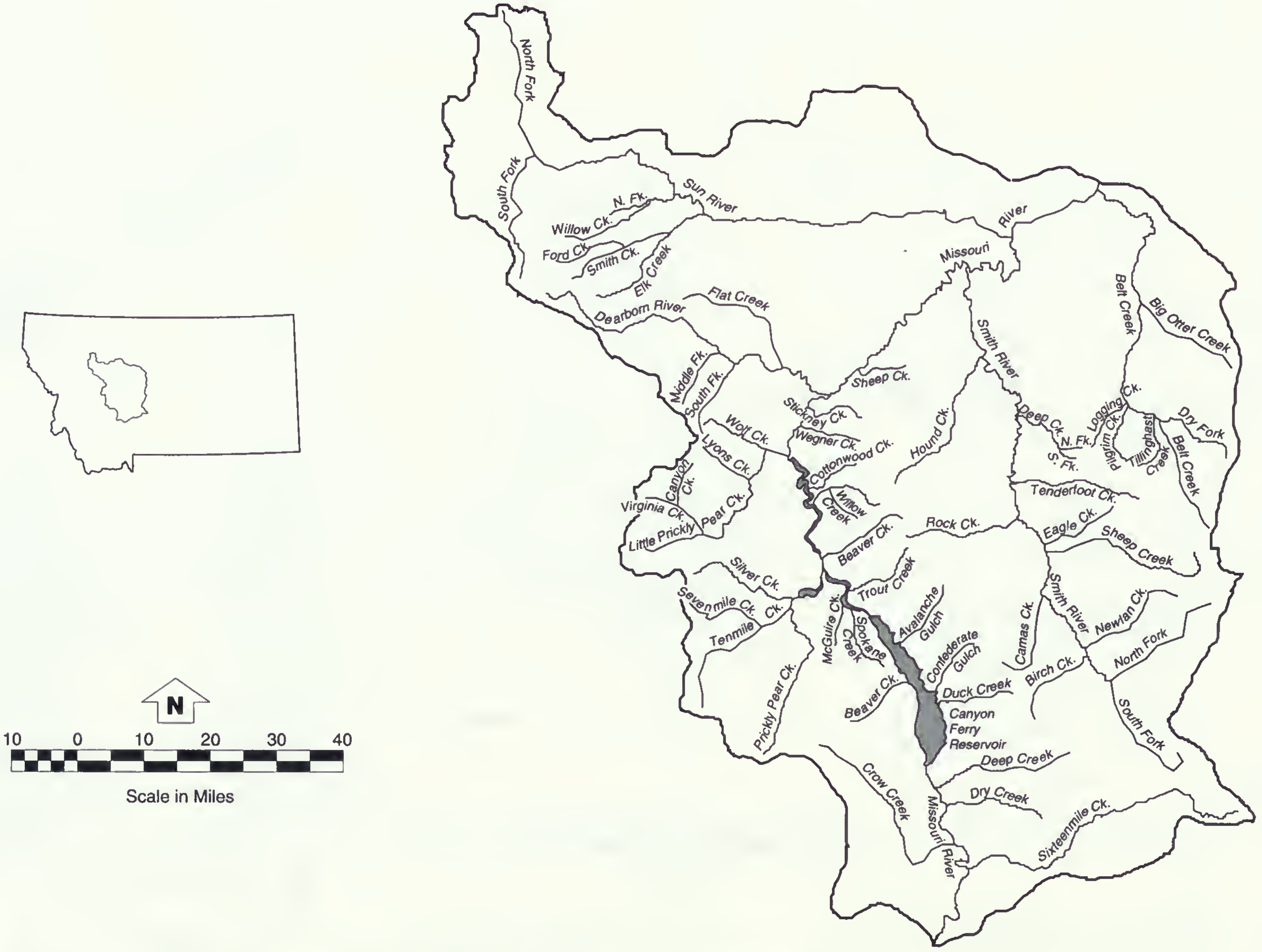
Madison Drainage
Black Sand Spring Creek
Duck Creek

Beaverhead-Red Rock Drainage
Trapper Creek
North Fork Frying Pan Creek
South Fork Frying Pan Creek

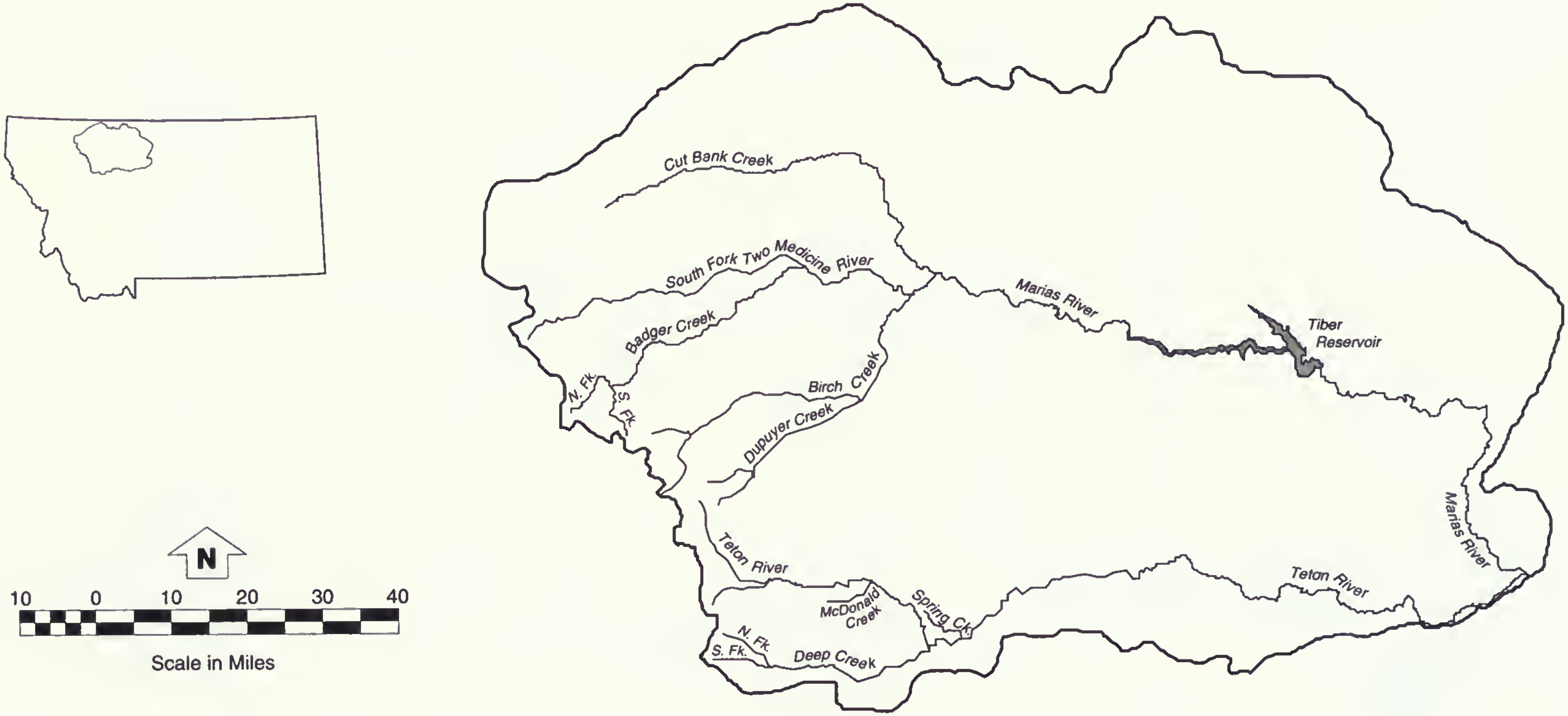
Ruby Drainage
East Fork Ruby River
Corral Creek
West Fork Ruby River

Gallatin Drainage
Baker Creek
Ben Hart Creek

Map 1-6. Streams where instream flows have been requested in the Upper Missouri Subbasin


North Fork
South Fork
Sun River
N. Fk.
Willow Ck.
Ford Ck.
Smith Ck.
Elk Creek
Dearborn River
Flat Creek
Missouri
River
Middle Fk.
South Fk.
Wolf Ck.
Lyons Ck.
Canyon Ck.
Virginia Ck.
Little Prickly Pear Ck.
Stickney Ck.
Wegner Ck.
Cottonwood Ck.
Sheep Ck.
Hound Ck.
Willow Creek
Beaver Ck.
Rock Ck.
Silver Ck.
Sevenmile Ck.
Ck.
Tenmile
Prickly Pear Ck.
McGuire Ck.
Spokane Creek
Trout Creek
Avalanche Gulch
Confederate Gulch
Beaver Ck.
Duck Creek
Canyon Ferry Reservoir
Deep Creek
Crow Creek
Dry Creek
Missouri River
Sixteenmile Ck.
Camas Ck.
Birch Ck.
South Fork
North Fork
Smith River
Newlan Ck.
Sheep Creek
Eagle Ck.
Tenderfoot Ck.
Smith River
Deep Ck.
N. Fk.
S. Fk.
Logging Ck.
Pilgrim Ck.
Tillinghast Creek
Belt Creek
Dry Fork
Belt Creek
Big Otter Creek
N
10 0 10 20 30 40
Scale in Miles

Map 1-7. Streams where instream flows have been requested in the Marias/Teton Subbasin


Cut Bank Creek
South Fork Two Medicine River
Badger Creek
N. Fk.
S. Fk.
Birch Creek
Dupuyer Creek
Marias River
Tiber Reservoir
Teton River
McDonald Creek
Spring Ck.
N. Fk.
S. Fk.
Deep Creek
Teton River
Marias River
N
10 0 10 20 30 40
Scale in Miles

Map 1-8. Streams where instream flows have been requested in the Middle Missouri Subbasin

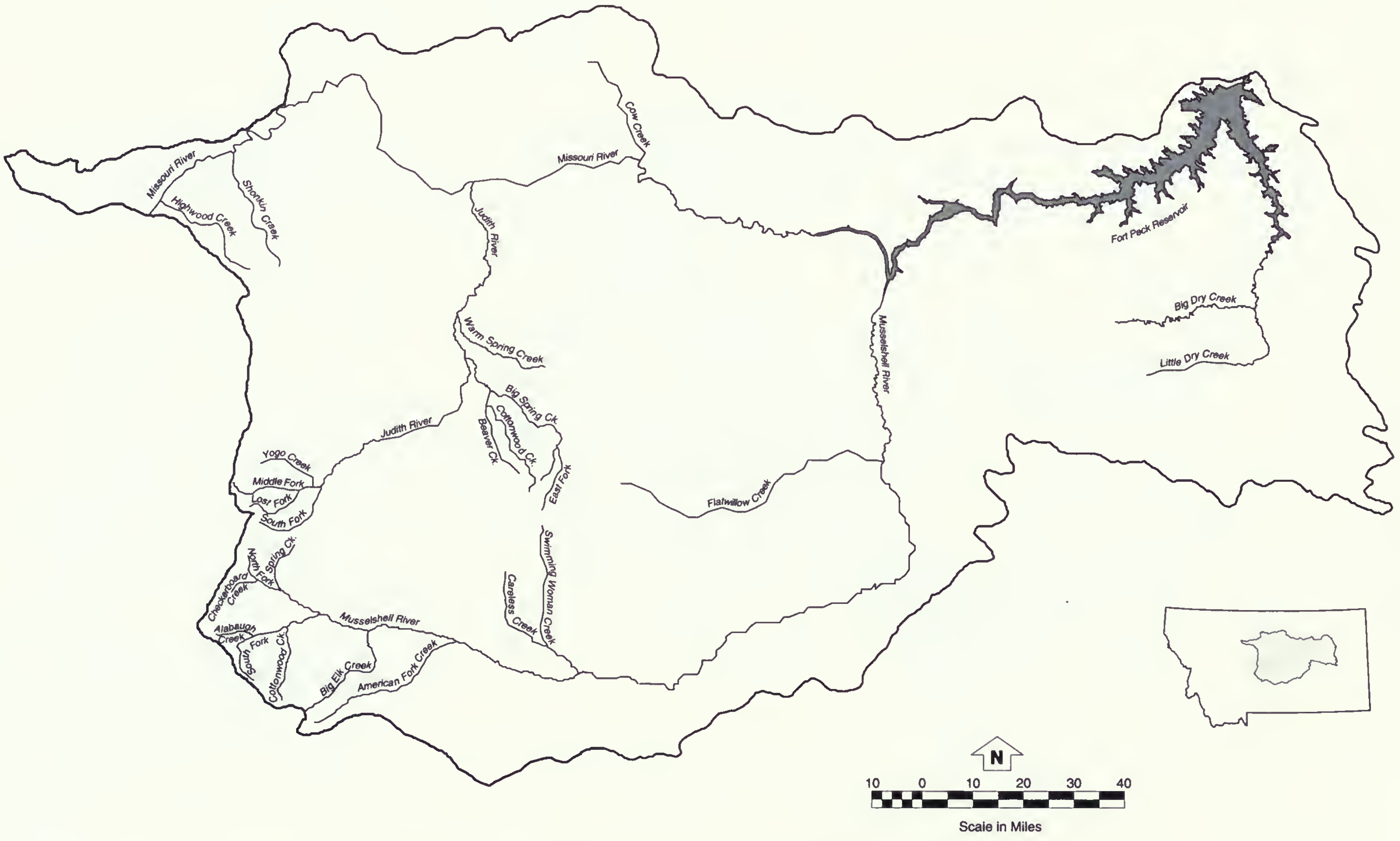

Cow Creek
Missouri River
Missouri River
Highwood Creek
Shonkin Creek
Judith River
Fort Peck Reservoir
Big Dry Creek
Little Dry Creek
Musselshell River
Warm Spring Creek
Big Spring Ck.
Cottonwood Ck.
Beaver Ck.
East Fork
Judith River
Yogo Creek
Middle Fork
Lost Fork
South Fork
Flatwillow Creek
Swimming Woman Creek
Careless Creek
North Fork
Spring Ck.
Checkerboard Creek
Alabaugh Creek
South Fork
Cottonwood Ck.
Musselshell River
Big Elk Creek
American Fork Creek
N
10
0
10
20
30
40
Scale in Miles

Table 1-3. Amounts requested by DHES to protect water quality

Stream	Amount cfs	Amount acre-feet/year
Missouri River at Toston	2,596	1,879,504
Missouri River at Ulm	3,204	2,319,696
Missouri River at Virgelle	4,390	3,178,360
Missouri River at Landusky	4,815	3,486,060

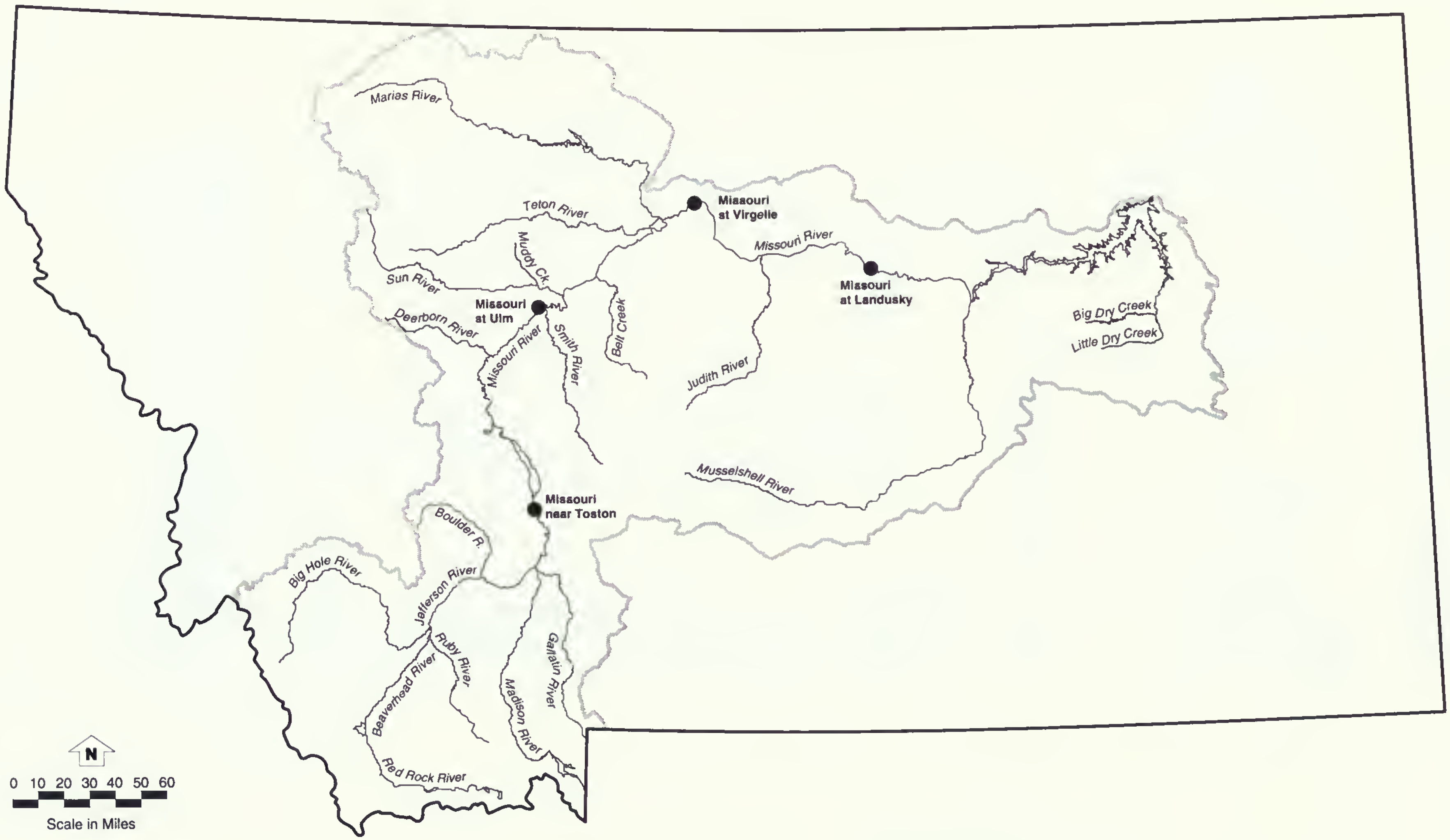
Source: DHES 1989

Table 1-4. Reservations requested by municipalities

Municipality	Source	Amount cfs	Amount acre-feet/year
Belgrade	Wells (2)	3.56	645
Bozeman	Sourdough (Bozeman) Creek	327.00	6,000
Chester	Marias River	1.00	435
Choteau	Wells (4)	1.84	482
Conrad	Lake Frances (inactive pool)	5.45	1,322
Cut Bank	Cut Bank Creek	3.37	890
Dillon	Well	1.11	202
East Helena	McClellan Creek and wells	0.93	258
Fairfield	Wells (2)	0.34	100
Fort Benton			
Municipal	Missouri River	0.76	89
Parks Irrigation	Missouri River	0.67	35
Great Falls			
Municipal	Missouri River	28.16	10,642
Parks Irrigation	Missouri River	4.45	233.5
Parks Irrigation	Sun River	4.45	233.5
Helena	Wells (6-8)	16.4	7,071
Lewistown	Big Spring Creek	3.57	2,966
Power	Muddy Creek	0.27	62
Shelby	Wells (4-8)	1.83	302
Three Forks	Wells (2)	0.45	81
West Yellowstone	Whiskey Spring	3.53	2,550
Winifred	Well	0.26	60

Sources: City of Belgrade 1987, City of Bozeman 1987, City of Chester 1988, City of Choteau 1988, City of conrad 1988, City of Cut Bank 1988, City of Dillon 1987, City of East Helena 1988, City of Fairfield 1988, City of Fort Benton 1988, City of Great Falls 1988, City of Helena 1989, City of Lewistown 1988, Power Teton County 1988, City of Shelby 1988, City of Three Forks 1987, City of West Yellowstone 1987, City of Winifred 1988.

Map 1-9. Points on the Missouri River where DHES has applied to reserve water


Marias River
Teton River
Muddy Ck.
Sun River
Deerborn River
Missouri at Ulm
Missouri River
Smith River
Belt Creek
Missouri at Virgelle
Missouri River
Missouri at Landusky
Judith River
Musselshell River
Big Dry Creek
Little Dry Creek
Missouri near Toston
Boulder R.
Big Hole River
Jefferson River
Ruby River
Beaverhead River
Red Rock River
Madison River
Gallatin River
N
0 10 20 30 40 50 60
Scale in Miles

Map 1-10. Municipalities that have applied to reserve water in the basin

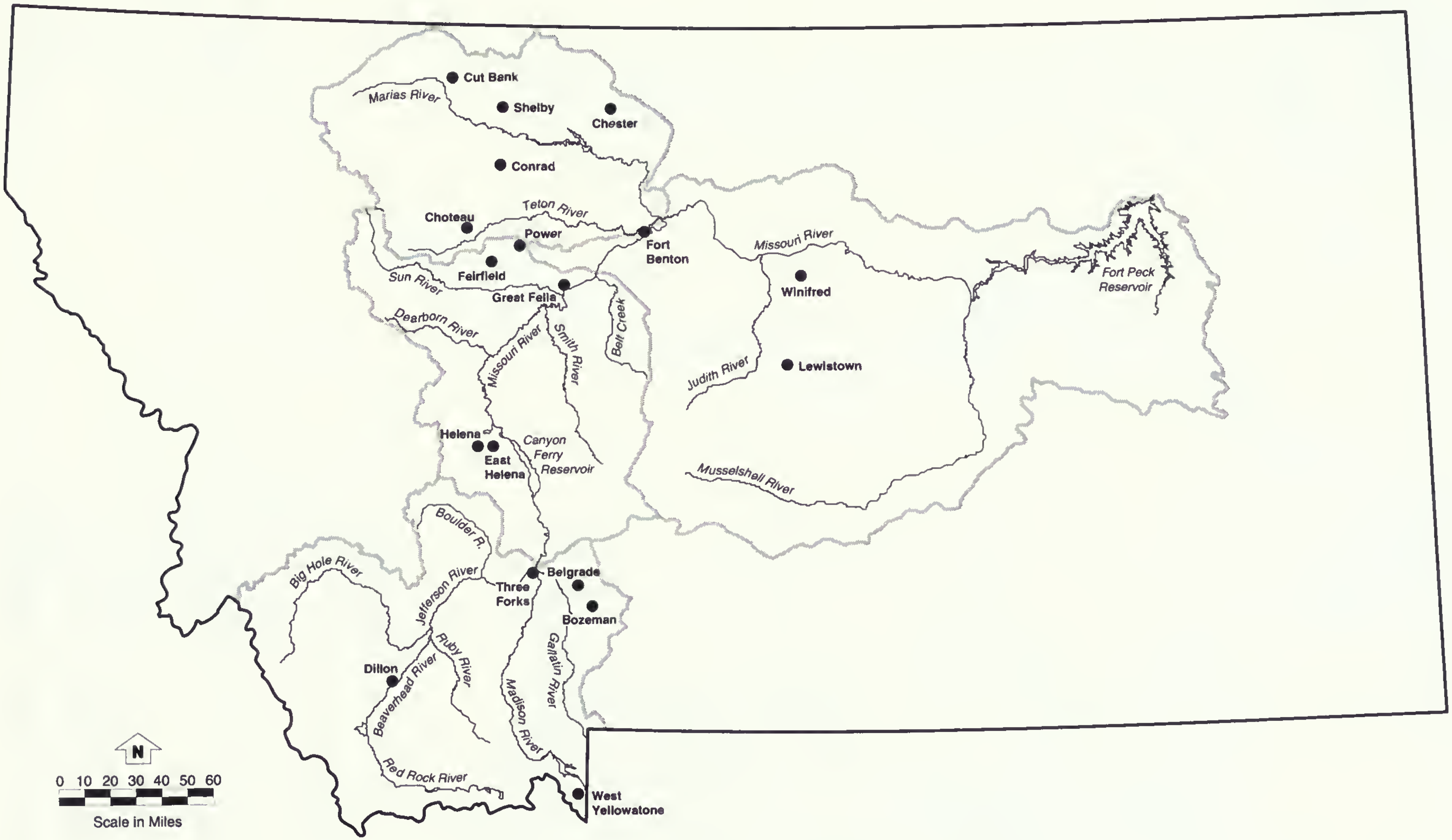

Cut Bank
Marias River
Shelby
Chester
Conrad
Teton River
Choteau
Power
Fort Benton
Missouri River
Fairfield
Sun River
Great Falls
Winifred
Fort Peck Reservoir
Dearborn River
Missouri River
Smith River
Belt Creek
Judith River
Lewistown
Helena
East Helena
Canyon Ferry Reservoir
Musselshell River
Boulder R.
Big Hole River
Jefferson River
Three Forks
Belgrade
Bozeman
Ruby River
Dillon
Beaverhead River
Gallatin River
Madison River
Red Rock River
West Yellowatone
N
0 10 20 30 40 50 60
Scale in Miles

Table 1-5. Reservations requested by BLM for maintenance of aquatic habitat and stream channels

	Amount		
	Year-round for aquatic habitat maintenance		Peak discharge every other year for channel maintenance
Stream	cfs	acre feet/year	cfs
Bear Creek near Grant	6	4,344	50
Bear Creek near Wise River	2.5	1,810	50
Big Sheep Creek near Dell	40	28,960	300
Black Canyon Creek near Grant	2.5	1,810	35
Bloody Dick Creek near Grant	20	14,500	270
Cabin Creek near Dell	1	724	4
Canyon Creek near Divide	5	3,620	110
Camp Creek near Melrose	5	3,600	50
Corral Creek near Lakeview	2.5	1,810	20
Deadman Creek near Dell	4.5	3,258	50
Deep Creek near Wise River	30	21,720	500
East Fork Blacktail Deer Creek near Dillon	18	13,032	215
East Fork Dyce Creek near Dillon	1.5	1,086	9
Frying Pan Creek near Grant	1.5	1,086	35
Hell Roaring Creek	15	10,860	250
Indian Creek near Dell	1	724	5
Jones Creek near Lakeview	2	1,428	20
Long Creek near Lakeview	5	3,620	110
Medicine Lodge Creek near Grant	9	6,516	50
Moose Creek near Divide	8	5,800	70
North Fork Greenhorn Creek near Alder	3.5	2,534	35
Odell Creek near Lakeview	11	7,964	225
Peet Creek near Lakeview	1.5	1,090	30
Rape Creek near Grant	1	724	5
Shenon Creek near Grant	1	724	13
Simpson Creek near Dell	1	724	5
Tom Creek near Lakeview	2	1,448	25
Trapper Creek near Grant	1	724	10
West Fork Blacktail Deer Creek near Dillon	3	2,172	25
West Fork Dyce Creek near Dillon	1	724	5
Willow Creek near Glen	12	8,900	130

Source: BLM 1989

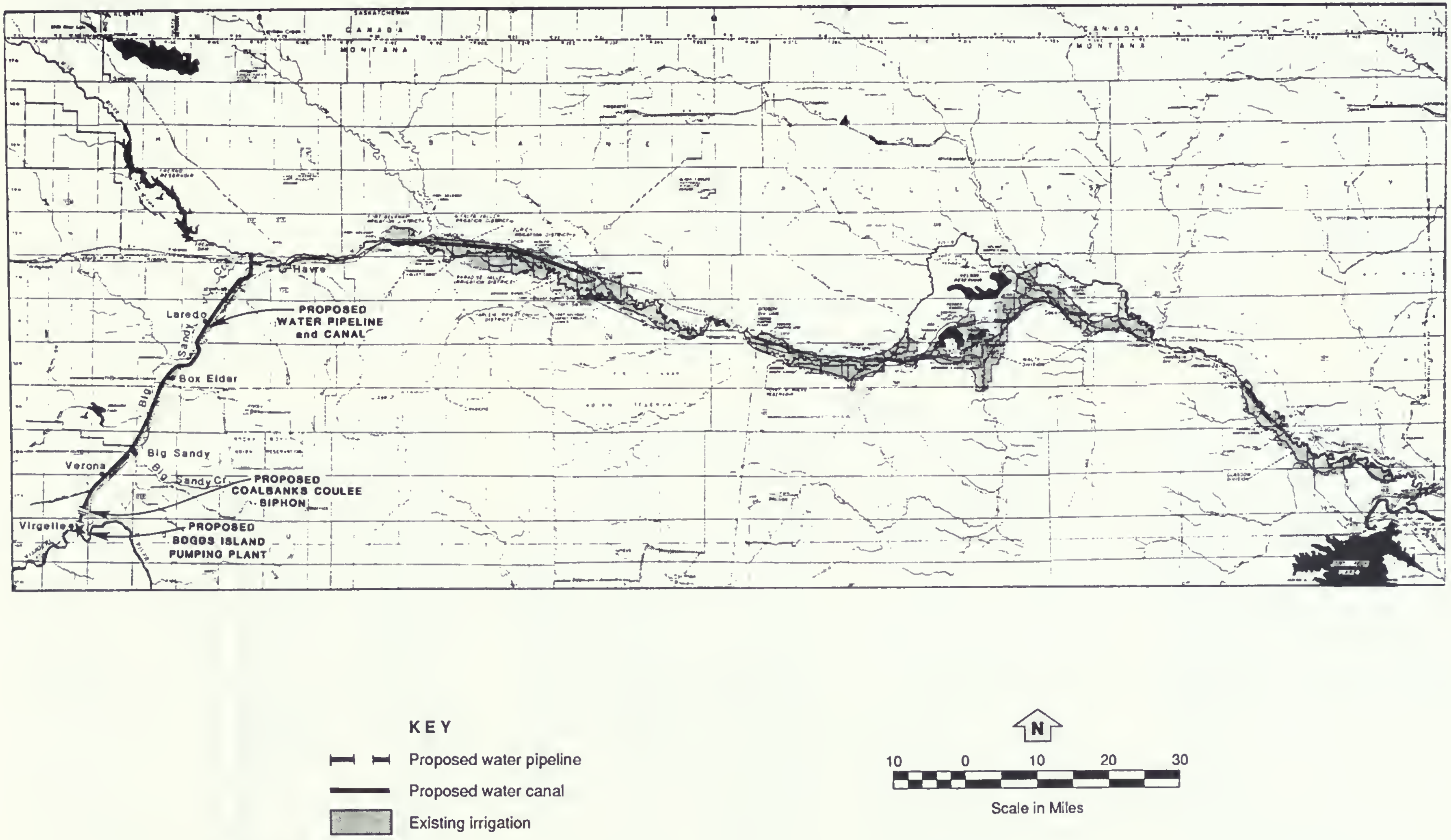
Table 1-6. U.S. Bureau of Reclamation reservation request

BUREC would reserve water for the following purposes:

1. Supplemental irrigation water (46,400 acre-feet) for 33,000 acres along the Milk River
2. Supplemental irrigation water (10,000 acre-feet) for 14,000 acres on the Fort Belknap Indian Reservation
3. New full service irrigation (5,800 acre-feet) for 3,300 acres on Rocky Boys Indian Reservation
4. New full service irrigation (5,900 acre-feet) for 3,300 acres along the proposed canal between the Missouri and Milk rivers
5. 13,000 acre-feet for Lake Bowdoin National Wildlife Refuge
6. 7,500 acre-feet for BLM stock ponds
7. 400 acre-feet for the town of Chinook

The amount of water requested is 280 cfs from April 1 to October 30 for a total volume of 89,000 af per year.

Map 1-11. Proposed Bureau of Reclamation diversion project


SASKATCHEWAN
CANADA
MONTANA
ALBERTA
Havre
Laredo
Big Sandy Cr.
Box Elder
Big Sandy
Verona
Virgelle
PROPOSED WATER PIPELINE and CANAL
PROPOSED COALBANKS COULEE SIPHON
PROPOSED BOGGS ISLAND PUMPING PLANT
KEY
Proposed water pipeline
Proposed water canal
Existing irrigation
N
10
0
10
20
30
Scale in Miles

MONTANA WATER LAW

Water use in Montana is generally guided by the prior appropriation doctrine. One of the legal principles under the prior appropriation doctrine is "first in time is first in right." The first person to use water from a source establishes the first right, the second person is free to divert flows from what is left, and so on. During a dry year, the person with the earliest priority date has first chance at the available water to the limit of his or her established right.. The holder of the second earliest priority date has the next chance, and so on.

Another central element of the prior appropriation doctrine is that the water must be put to beneficial use. The Montana Supreme Court has stated that beneficial use is the "basis, measure, and limit" of a water right. *McDonald v. State*, 220 Mont. 519 (1986). Under Montana law, beneficial uses include, but are not limited to, agriculture (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses. The nature and extent of a water right is defined by how water has been beneficially used in the past. Once a water right is established, it can be lost through abandonment if the beneficial use is not continued.

Under the prior appropriation doctrine in Montana, there are various "types" of water rights, depending on what procedure for obtaining a water right was in force at the time the right was established. However, the basic principles of first in time, first in right, and beneficial use apply to all types of water rights acquired under state law.

The most significant change in how water rights are created and administered occurred in 1973 when the legislature enacted the Montana Water Use Act. The Water Use Act, effective July 1, 1973, recognized and confirmed water rights that had been used in the past. But, because there were only incomplete records to determine what water had been used, the act also created a system for filing claims and adjudicating those historical rights. This adjudication process also includes water rights claimed under federal law by Indian tribes and the federal government.

Further, the act established a new administrative permit system for obtaining a water right after July 1, 1973.

WATER RESERVATIONS

Montana has created an additional class of water rights labeled water reservations. Under the water reservation system, water is appropriated for instream or future water-consuming uses. Essentially, water reservations are very similar to water right permits. However, there are important distinctions in who can hold reservations, the requirements for establishing the reserved rights, the process for obtaining them, and in some cases the possibility of having the rights reallocated to another use. Under the water reservation statute, only state or federal agencies or political subdivisions of the state may apply for a water reservation (§85-2-316(1), MCA).

The water reservation statute allows water to be appropriated in the present for consumptive use in the future. By appropriating the water now, the reservant maintains an early priority date, even though it may be years or decades before the water is actually developed.

The water reservation statute is the only means to acquire a water right for instream flows to protect water quality, fish, wildlife, and recreation. The purpose of instream flows is to maintain a minimum flow, level, or quality of water throughout the year, or a period, or for a length of time designated by the Board. These flows can be reserved without the usual requirement for withdrawal, impoundment, or diversion of the water and implemented immediately upon being granted.

Water reservations cannot adversely affect the amount of water legally available to holders of water rights with a priority date earlier than July 1, 1985. However, if an existing water right user wishes to change the point of diversion, place of use, purpose of use, or place of storage, all senior and junior water right holders,including those with water reservations, have a right to object to the change if they feel that the exercise of their water rights would be adversely affected. This same legal right allows holders of water reservations to object to water right claims submitted in the statewide adjudication proceeding. Holders of water reservations, like all other water right holders, may seek relief from the district court to protect their water rights.

The Board of Natural Resources and Conservation is responsible for issuing orders adopting water reservations. Before an order reserving water may be adopted, each applicant must establish to the Board's satisfaction:

1. The purpose of the reservation;
2. The need for the reservation;
3. The amount of water necessary for the purpose of the reservation; and
4. That the reservation is in the public interest.

The Board's decision-making process regarding water reservations is covered by the Administrative Procedure Act (APA). Under APA, appeal for judicial review by the district court is provided for any party who fully participates in the contested case hearing (typically not persons offering public testimony only) and who is aggrieved by the Board's final decision (§2-4-704(1), MCA).

However, the district court is limited in what it can review. The court will review only the record established by the Board and will not consider new evidence or testimony unless the appellant can show good reason why it was not presented to the Board. The court cannot substitute its judgment for the Board's, but can modify or reverse the Board's decision if:

1. The administrative findings, inferences, conclusions, or decisions are:
    (a) In violation of constitutional or statutory provisions;
    (b) In excess of the statutory authority of the agency;
    (c) Made upon unlawful procedure;
    (d) Affected by other error of law;
    (e) Clearly erroneous in view of the reliable, probative, and substantial evidence on the whole record;
    (f) Arbitrary or capricious or characterized by abuse of discretion or clearly unwarranted exercise of discretion; or
2. Findings of fact upon issues essential to the decision were not made, though they were requested (§2-4-704(2)(a,b), MCA).

The district court's decision can be appealed to the Montana Supreme Court.

A water reservation, when granted, becomes a water right. However, if the objectives of the reservation are not being met, the Board can later modify or revoke it. The Board must review water reservations at least once every 10 years to ensure that the objectives of the reservation are being met. In the case of instream flows granted by the Board, all or a portion of the flow may be reallocated to a different use if the applicant for reallocation is a qualified reservant and can show that the instream flow is not required for its purpose and that the need for reallocation to the applicant outweighs the need shown by the original reservant (§85-2-316(11), MCA).

All water reservations granted in the Missouri River basin under the present reservation process will have a priority date of July 1, 1985 (§85-2-316, MCA). However, the Board must set the relative priorities within the July 1, 1985, date for the different reservations. In other reservation proceedings (on the Yellowstone River), the Board accomplished this by granting different reservations at different times of the day. Reservations granted at 8 a.m. would be senior to those granted at 8:01, for example.

Persons who receive a water use permit on the Missouri River with a priority date between July 1, 1985, and the date the Board adopts an order granting a water reservation, may seek to have any or all reservations subordinated to the permit. However, for the Board to subordinate a reservation to a permit, the permit holder must show that the subordination will not interfere substantially with the purpose of the reservation.

ALTERNATIVES

To address the full range of potential impacts and options available to the Board, DNRC selected four alternatives to analyze in the draft EIS; the Consumptive Use, Instream, Combination, and No Action alternatives.

Municipal reservations were given highest priority under all but the No Action Alternative because of the relatively small amount of water requested for municipal use and the importance of sufficient water supplies for communities.

The Consumptive Use Alternative emphasizes the use of water for irrigation and municipal purposes. First preference in this alternative goes to municipalities, followed by proposed irrigation projects, and then instream uses. All irrigation projects proposed in the reservation applications were included in this alternative.

The Instream Alternative gives first priority to municipal uses, but emphasizes instream reservations for the protection of fish, wildlife, recreation, and water quality. Irrigation would have third priority.

To some extent, the Combination Alternative is similar to the Consumptive Use Alternative in that it gives first preference to municipalities, second to proposed irrigation projects, and third to instream uses. It differs primarily in that proposed irrigation projects are only included if they are economically and financially feasible at least 50 percent of the time. A few other projects were excluded or reduced in size based on concerns about land use or other environmental considerations.

Under the No Action Alternative, DNRC describes trends that might unfold through the year 2025 if no water is reserved for any purpose.

CHAPTER TWO

PROJECT UPDATE AND NEW INFORMATION

INTRODUCTION

This chapter provides information that was obtained or developed by DNRC subsequent to preparation of the draft EIS. Information regarding two additional alternatives—one emphasizing water quality protection and another that would grant only municipal and instream reservations—is included at the request of people who commented on the draft EIS. Updated information pertaining to the listing and distribution of threatened or endangered fish also is presented.

In its relicensing application to the Federal Energy Regulatory Commission, Montana Power Company proposes to upgrade its hydroelectric generation facilities on the Missouri and Madison rivers. These upgrades would provide about 68 additional MW of generating capacity. The draft EIS did not examine possible effects of the proposed reservations on upgraded hydroelectric generation at MPC's dams. The possible effects of reservations on the upgrades proposed by MPC are included.

Several of the assumptions used to determine the benefits and costs of the alternatives in Chapter Seven of the draft EIS have since been refined. The costs and benefits of the alternatives analyzed in the draft EIS have been revised on the basis of these refinements. Costs and benefits of the two new alternatives also have been estimated using the revised assumptions.

In the draft EIS, DNRC used the Missouri River water availability model to investigate the possibility of altering operations of Canyon Ferry Reservoir to maintain or enhance MPC headwater benefits. This analysis was performed for the 1986 level of irrigation development and for the conditions that would result from the Consumptive Use Alternative. The draft EIS stated that further such analysis would be included in the final EIS. Few comments were received on the draft EIS regarding this topic. DNRC now feels that information presented in the draft EIS regarding this subject was adequate because the scenarios examined encompass the range of possible impacts. No further such analysis is included in the final EIS.

WATER QUALITY ALTERNATIVE

Several commenters expressed concern that any new consumptive use would increase arsenic concentrations in the Missouri River and some tributaries. They therefore requested consideration of a water quality alternative that would include only reservations for instream flows. They reasoned that such an alternative would avoid adverse water quality impacts associated with consumptive water use. DNRC has included a water quality alternative in the final EIS. This alternative includes only instream reservations. Instream reservation requests that exceed 50 percent of the average annual flow of record have been reduced as required by law. The impacts of this alternative are described as follows.

WATER AVAILABILITY

The Water Quality Alternative would not affect existing streamflows or water rights before July 1, 1985. However, it would reduce the amount of water for appropriation by new permits. Small increases in flows could occur on some streams if instream reservations reduce water use associated with permits issued after July 1, 1985. The streamflow distributions for this alternative would be the same as those for baseline conditions presented in Appendix C of the draft EIS.

WATER QUALITY

Under the Water Quality Alternative, existing water quality in the Missouri River and its tributaries would not change substantially. However, the alternative would limit further flow depletions, thereby helping to prevent increases in arsenic, suspended sediments, total dissolved solids (TDS), and water temperatures, and decreases in dissolved oxygen levels, especially during times of low flow. Instream reservations also would help to maintain dilution of discharges of acid and toxic metals from operating and abandoned mines that contaminate streams in the upper Wise River, Boulder River, Belt Creek, and Grasshopper Creek drainages. By maintaining the streams' abilities to dilute pollutants, instream flow reservations granted under the Water Quality Alternative also would help to protect holders of wastewater discharge permits from added treatment costs.

SOILS AND LAND USE

Instream reservations under the Water Quality Alternative would not directly affect soils or land use, but might indirectly affect soils and land use by limiting future consumptive uses.

FISHERIES

Instream reservations included in the Water Quality Alternative would help preserve existing aquatic habitat and fisheries as described in Chapter Four of the draft EIS. Reservation of instream flows would not limit the exercise of existing water rights or offer protection from natural conditions that already cause severe low flows that adversely affect aquatic habitat.

WILDLIFE, VEGETATION, AND RECREATION

Existing vegetation and wildlife populations would not be adversely affected under the Water Quality Alternative. Instream flow reservations would help maintain existing opportunities for recreation.

HISTORICAL, ARCHAEOLOGICAL, AND PALEONTOLOGICAL RESOURCES

The reservation of water for instream flow purposes would have no foreseeable effects on historical, archaeological, or paleontological resources.

POWER PRODUCTION

The Water Quality Alternative would not allow reservations for consumptive uses, so existing levels of hydropower production would be maintained. No reservation for projects that consumptively use water would be approved, so there would be no increase in electrical demand for such use.

SOCIAL AND ECONOMIC EFFECTS

Economic benefits to agriculture that could realized under the Consumptive Use, Combinati or Instream alternatives as described in the draft would not occur. The establishment of some stream flow reservations would not noticeably cha the character of Missouri River basin communiti There would be no direct effect on population or m community services. Municipal water suppl would have to be obtained from other sources, or condemnation of existing water rights. The rec ation and tourism-related services still would con tute a growing segment of the basin economy.

MUNICIPAL ALTERNATIVE

Several commenters suggested the addition o alternative limited to municipal and instream res vations because they felt it would provide the m economic benefit of any alternative. In respon DNRC developed the Municipal Alternative, wh includes reservations for municipal purposes w first priority of use, and reservations for instre flow with second priority of use. No reservations irrigation use are included in this alternative. required by statute, requests for instream reser tions have been limited to 50 percent of the aver annual flow on gauged streams. This alterna does not result in greater economic benefits than Instream Alternative, as explained at the end of chapter. Impacts of the Municipal Alternative described below.

WATER AVAILABILITY

The Missouri River water availability model used to assess how streamflows would change un the Municipal Alternative (see Appendix B). For 35 locations examined in the model, streamflow ductions would be less than 1 percent for all mon during wet, average, and dry years.

Streamflow patterns in Sourdough Creek wo be altered with the completion of the proposed re voir by the City of Bozeman. However, the timing magnitude of these alterations are difficult to dict, given the lack of detail regarding reservoir erations in the city's application.

WATER QUALITY

People in communities that use Missouri River wa could face a small increased risk of developing s cancer due to slight arsenic increases in their dr ing water. As with municipal users under all alternatives, this increase, should it occur, would be small since cities use relatively small amounts of water, and water treatment by some cities actually decreases arsenic. Affected communities are shown in Table 6-8 of the draft EIS. Health risks would be less under the Municipal Alternative than for any other alternative except the Water Quality Alternative. Under the Municipal Alternative, reservations for instream flows would have the same impacts as those described under the Water Quality Alternative.

SOILS

Municipal requests generally would have minor adverse effects on soils. Soil erosion and compaction would occur at well sites, at storage tank construction sites, and along pipeline routes. Short-term losses in soil productivity would occur until revegetation stabilizes disturbed areas. Impacts of reservations for instream flows are the same as those described under the Water Quality Alternative.

LAND USE

Municipal water reservations generally would require development of a water source (well or water intake structure) and a pipeline to the municipal water treatment facility. In most cases, these developments involve short-term construction activities, with the bulk of the affected land returning to former uses. The exception would be the City of Bozeman's proposed reservoir on Sourdough Creek south of Bozeman. This project would change land use in the Gallatin National Forest and on other private and municipal land, inundating up to 118 acres. Development of water under the municipal reservation also could involve modifications or construction of electric lines just south of Bozeman.

Instream reservations generally would have little direct effect on land use, but might constrain future irrigation development in some areas.

FISHERIES

With the exception of Bozeman's reservation request, most municipal reservations would have only minor effects on aquatic habitat and fish populations. Fishery impacts of Bozeman's proposed dam are difficult to estimate because of uncertainties about reservoir operations. However, about 1.25 miles of stream habitat would be flooded. It is not known if reservoir operation would sustain a long-term fishery in the reservoir or in Sourdough Creek below the proposed dam. In Sourdough Creek near the National Forest boundary, the reservation might reduce flows below 11 cfs, which is thought necessary to maintain food-producing riffle areas (DFWP 1989). Flows already fall below 11 cfs during the fall and winter (USGS 1989).

As with the Consumptive Use, Instream, and Combination alternatives, the slight reductions in flow in the Beaverhead River from Dillon's request would have a minor effect on already-poor, downstream aquatic habitat conditions during dry years.

Reservations for instream flow would help maintain aquatic habitat as described under the Water Quality Alternative.

WILDLIFE AND VEGETATION

Impacts of municipal reservations on wildlife would be small except for Bozeman's proposed dam on Sourdough Creek. Approximately 1.25 miles of streamside riparian habitat used by moose and white-tailed deer would be flooded. Approximately 118 acres of elk winter range also would be flooded by the reservoir. This impact would be the same as that described for the Consumptive Use, Instream, and Combination alternatives in the draft EIS.

The reservoir proposed by Bozeman would flood about 118 acres of native plant communities. Riparian and upland communities would be lost, and unvegetated mudflats would be created by reservoir drawdown. These unvegetated areas would have a high potential for invasion by weeds when reservoir levels are lowered. There would be little potential for growth of desirable shoreline plants such as willows, sedges, and rushes, due to the seasonal fluctuations in water levels. Control of noxious weeds may be required on and along reservoir shorelines.

Impacts of reservations for instream flow on vegetation and wildlife would be the same as those described under the Water Quality Alternative.

HISTORICAL, ARCHAEOLOGICAL, AND PALEONTOLOGICAL RESOURCES

No known archaeological, historical, or paleontological sites would be affected under the Municipal Alternative. Both Bozeman and Belgrade have sites listed on the National Register of Historic Places, but none of these would be directly affected. Several sites are located near the City of Bozeman's proposed project, but additional field work would be required to determine the importance and whether retrieval of information and artifacts is necessary. Other municipal reservations would not affect known resources.

The reservation of water for instream flow purposes would have no foreseeable effects on historical, archaeological, or paleontological resources beyond those occurring at present.

RECREATION

Except as noted below, municipal water reservations would have little effect on instream flows and water-based recreation. Similarly, instream reservations would not reduce flows below present levels and would help maintain existing opportunities for recreation.

Bozeman's municipal reservation would affect recreation on Sourdough Creek under the Municipal Alternative, but impacts would depend on reservoir operation and release patterns as described in the draft EIS. These variables are not clearly defined in the application. The potential for recreation at the proposed reservoir site cannot be predicted until project design is complete. Recreation use on lower Prickly Pear Creek might decrease as a result of Helena's reservation if well pumping affects flows in the creek.

POWER PRODUCTION

DNRC estimated that water use under the Municipal Alternative would reduce generation at dams above Fort Peck an average of 0.037 gigawatt-hours (GWh) per year. Generation at Fort Peck would be reduced by 0.017 GWh, and the output of the five lower Missouri dams in downstream states would be reduced by 0.059 GWh. If replacement power costs 50 mills/kWh (5 cents kWh), the cost to utility ratepayers would average $5,650 per year. If replacement power costs 100 mills/kWh (10 cents/kWh), the annual costs to ratepayers would be $11,300. Society would have to bear the environmental costs of approximately 0.113 GWh per year of new generation.

Projects in the Municipal Alternative would use about 8.62 GWh per year. The costs that would be imposed on all other electricity consumers would be $86,200 per year if the cost of replacement power were 50 mills/kWh (5 cents/kWh), or $517,400 if the replacement cost were 100 mills/kWh (10 cents/kWh).

The total power losses in Montana under the Municipal Alternative would be 8.67 GWh per year, about .07 percent of Montana's annual consumption. The cost of replacing this power would be around $88,900 to $522,800. For comparison, this amounts to approximately 0.02 to 0.10 percent of current Montana sales of electricity. The total impact to all ratepayers of full development under the Municipal Alternative would be from $90,000 per year, assuming a power replacement cost of 50 mills/kWh, to $530,000 per year, assuming power replacement costs of 100 mills/kWh. Assuming a 70-year life for the projects and a 4.6 percent discount rate, total cost to ratepayers would be $1.9 to $11.0 million.

SOCIAL AND ECONOMIC EFFECTS

The Municipal Alternative would preclude some economic benefits and costs to agriculture that could be realized with reservations for new irrigation. These benefits are indicated in Tables 6-44, 6-45, 6-46, 6-47 and 6-48 of the draft EIS.

There would be no direct effect on population or on most community services. Municipal water supplies would be secure where reservations are obtained.

Impacts resulting from reservations for instream flow under the Municipal Alternative would be the same as those described in the draft EIS.

THREATENED AND ENDANGERED FISH

FLUVIAL ARCTIC GRAYLING

On October 3, 1991, USFWS received a petition from the Biodiversity Legal Foundation and George Wuerthner (Carlton 1991) to list the stream-dwelling arctic grayling as an endangered species. The petitioners seek the endangered listing throughout the stream-dwelling arctic grayling's known historical range in the lower 48 states. Also sought is a designation of critical habitat.

In the petition, three threats to the stream-dwelling arctic grayling and its habitat were identified. First is the fact that the grayling is easily caught by fishermen. Past harvest by fishermen may have reduced grayling numbers. The second threat is competition from introduced trout species. The third threat is agricultural practices including overgrazing and irrigation water use.

As described in the draft EIS, the original range of the arctic grayling in the lower 48 states included Michigan and rivers and streams in the Missouri River drainage above Great Falls. Stream-dwelling arctic grayling are now absent from Michigan, and the only confirmed, genetically distinct stream-dwelling population in Montana is in the Big Hole River. Lake-dwelling populations of arctic grayling are secure in Montana.

USFWS must determine whether the petition has merit. If the petition has merit, USFWS must start the formal listing procedures. It is unlikely that these procedures will be completed before the Board's contested case hearing takes place.

PALLID STURGEON

Since preparation of the draft EIS, additional information has become available regarding distribution of pallid sturgeon above Fort Peck Dam. Gardner (1990) searched published documents and interviewed residents to help determine the past distribution of pallid sturgeon. This effort found records of 35 observations of the pallid sturgeon in the Missouri River between Fort Benton and Fort Peck Dam. This contrasts with the 12 sightings noted by Keenlyne (1989) that were reported in the draft EIS. DFWP captured five pallid sturgeon during 1990 in the Missouri River between Cow Island and Fort Peck Reservoir using set lines and trammel nets (Gardner 1991). DFWP's analysis of these five sturgeon indicates that they have not hybridized with shovelnose sturgeon.

EFFECTS OF PROPOSED RESERVATIONS ON HYDROELECTRIC GENERATION WITH PROPOSED MPC UPGRADES

MPC proposes to upgrade its hydroelectric generation facilities on the Missouri and Madison rivers as part of its relicensing application to the Federal Energy Regulatory Commission. Table 2-1 indicates the proposed modifications to MPC's facilities. Based on these changes, average monthly energy production would increase from 11 GWh to 13 GWh at Hauser Dam, from 24 to 32 GWh at Rainbow Dam, and from 39 to 47 GWh at Ryan Dam. Increases in energy production would result from increased turbine capacity and improved efficiency or power factor.

Assuming the hydropower facilities are upgraded under the current electrical rate structure, reservations for consumptive use would have greater impacts on power production than would occur under existing conditions (Table 2-2). Due to the uncertainty of the rate structure that may accompany the upgrade, the costs resulting from reduced power production at the upgraded facilities cannot be accurately estimated. However, if there is a rate increase, replacement costs will be less than those estimated.

PUBLIC INTEREST

In this section, DNRC presents two comparisons to assist the Board in its evaluation of the reservation requests. The first compares the relative costs and benefits of consumptive use and instream use considered under the five action alternatives. The second comparison examines whether the benefits exceed the costs for individual water reservations based on the value of an acre-foot of water for consumptive use or instream use in each subbasin.

BENEFITS AND COSTS UNDER THE ALTERNATIVES

The analysis of the five alternatives focuses on the consequences of granting the different water reservations. This analysis is general because actual costs

Table 2-1. Proposed modifications to MPC's hydroelectric generating facilities that would be affected by reservations

	Turbine Capacity[a]		Power Factor	
Site	Existing[b] (cfs)	Planned (cfs)	Existing[c] (MW/1000 cfs)	Planned[a] (MW/1000 cfs)
Hauser	4,740	4,740	3.8	4.4
Rainbow	5,400	8,000	6.5	7.25
Ryan	5,900	9,600	10.0	10.1

[a] Larry Gruel, Montana Power Company (1991)

[b] Turbine capacities used in the Missouri River water availability model are slightly different than values listed here. However, the differences are minor and their effects on model results are thought to be insignificant.

[c] Missouri River water availability model

Table 2-2 Costs of replacement power due to reduced hydroelectric production and increased electric loads for each alternative

	Alternative				
Existing Operations	**Consumptive**	**Instream**	**Combination**	**Municipal**	**Water Quality**
POWER COST-LOST PRODUCTION					
Reduced production (GWh)					
Upper Missouri	46	5	17	0[a]	0
Fort Peck	33	3	13	0[a]	0
Lower Missouri	103	12	43	0[a]	0
Total lost power production	182	20	73	0[a]	0
Replacement cost (million $)					
50 mill power	$ 9.1	1	$3.6	$0.0[a]	$0.0
100 mill power	$18.2	2	$7.3	$0.0[a]	$0.0
POWER COST-INCREASED LOAD					
Increased load (GWh)	183	40	101	9	0
Replacement cost (million $)					
50 mill power	$ 1.8	$0.4	$1.0	$0.0	$0.0
100 mill power	$10.9	$2.3	$6.0	$0.5	$0.0
TOTAL ANNUAL REPLACEMENT COST					
50 mill power	$10.9	$1.3	$ 4.6	$0.9	$0.0
100 mill power	$29.2	$4.3	$13.4	$0.5	$0.0
With MPC's Hydropower Upgrades and Current Rate Structure					
POWER COST-LOST PRODUCTION					
Reduced production (GWh)					
Upper Missouri	55	7	21	0[a]	0
Fort Peck	33	3	13	0[a]	0
Lower Missouri	103	12	43	0[a]	0
Total lost power production	191	22	77	0[a]	0
Replacement cost (million $)					
50 mill power	$ 9.5	$1.1	$3.8	$0.0[a]	$0.0
100 mill power	$19.1	$2.1	$7.7	$0.0[a]	$0.0
POWER COST-INCREASED LOAD					
Increased load (GWh)	183	40	101	9	0
Replacement cost (million $)					
50 mill power	$ 1.8	$0.4	$1.0	$0.0	$0.0
100 mill power	$10.9	$2.3	$6.0	$0.5	$0.0
TOTAL ANNUAL REPLACEMENT COST (million $)					
50 mill power	$11.4	$1.4	$ 4.8	$0.9	$0.0
100 mill power	$30.1	$4.5	$13.8	$0.5	$0.0

[a] Less than one-half a GWh or half a million dollars

and benefits cannot be known until after the Board determines which reservations are to be granted. Also, costs and benefits could change following granting of the reservations if the Board subsequently approves changes to the conservation districts' management plans, or modifies instream flows, or if DNRC approves changes in existing water rights. The estimated net present values for benefits and costs in these analyses are based on a 4.6 percent real discount rate over a 70-year period. Note that in the draft EIS, hydropower production, additional power use, recreation and municipal values were calculated with a 4.3 percent real discount rate. This has been changed to 4.6 percent.

BENEFITS

NEW IRRIGATION

DNRC analyzed the economic and financial feasibility of the irrigation proposals. Information used in the analysis included recorded crop yields, prices, and production costs. DNRC estimated net present values for 300 scenarios accounting for variability in future crop prices, production costs, and crop yields for each individual irrigation proposal. All but one of the proposed projects (GA-201) was assumed to have production costs and revenues associated with an alfalfa and barley rotation operation. The other project was assumed to have a rotation of seed potatoes, grain, and alfalfa. DNRC's analysis is described in Tubbs et al. (1989), with the exception of a slight deviation in deriving net present values. The net present values used in this analysis and in the draft EIS include all direct costs associated with producing, operating, maintaining, and developing irrigation projects. The irrigation benefits shown in Table 2-3 are the median value today of 70 years of returns less costs, meaning that half of the 300 scenarios analyzed have higher net returns and half have lower net returns. All of the net present values used in this analysis remain the same as those in the draft EIS. These values do not account for net returns accrued from existing farm operations; therefore, the estimated net present values for irrigation may be slightly inflated.

INSTREAM USES

None of the reservations included under the five alternatives would increase the value of instream uses but could prevent future depletions, thereby helping to maintain existing instream uses. Under existing conditions, the total value of recreation in the basin is $144 million per year (Duffield et al. 1990). Current annual hydropower production in the Missouri basin under average water conditions is 12,710 GWh per year. Of this amount, 3,550 GWh per year is produced at dams in Montana, and 9,160 GWh per year is produced at federal dams in downstream states.

The value of hydroelectric power production, based on replacement costs of 50 or 100 mills per kWh, is $180 to $355 million per year in Montana and $460 to $920 million per year in downstream states. The power from Pick-Sloan dams is currently sold at cost-based rates that are around 10.5 mills per kWh. MPC does not market its hydropower separately, but the cost of production is about 22.6 mills per kWh averaged over all MPC hydroelectric dams (MPC 1990). Leaving water instream also has value for preserving water quality, but this value has not been quantified.

MUNICIPAL USE

Water for municipal uses is worth at least what people are now paying for it. DNRC used Helena's rate of $2.47 per thousand gallons as an estimate of this value (see Appendix K of the draft EIS). The municipal benefits shown in Table 2-3 are the value today of 70 years of the proposed municipal use valued at $2.47 per thousand gallons, less costs. Municipal benefits are $324.0 million using a 4.6 percent real interest rate under all but the Water Quality Alternative. Since no municipal reservations are granted under the Water Quality Alternative, there are no net benefits.

COSTS

REDUCED RECREATION

Every alternative except the Water Quality Alternative could reduce future water-based recreation below its present levels. The estimated annual value of lost recreation due to lower flows under each alternative is shown in Table 2-4, which is an update of Table 6-42 in the draft EIS. Table 2-3 shows the cost today of 70 years of lost recreation. Costs for lost recreation are highest under the Consumptive Use Alternative ($78.3 million) and lowest under the Water Quality Alternative ($0).

Table 2-3. Benefits and Costs under five alternatives ($ million)[a,b]

	CONSUMPTIVE	INSTREAM	COMBINATION	MUNICIPAL	WATER QUALITY
IRRIGATION					
Headwaters	80.6	0.1	59.0	0.0	0.0
Upper Missouri	7.3	8.3	9.9	0.0	0.0
Marias/Teton	12.2	5.3	8.3	0.0	0.0
Middle Missouri	34.0	25.1	35.4	0.0	0.0
TOTAL	134.1	38.7	112.6	0.0	0.0
MUNICIPAL					
Headwaters	68.9	68.9	68.9	68.9	0.0
Upper Missouri	230.0	230.0	230.0	230.0	0.0
Marias/Teton	15.1	15.1	15.1	15.1	0.0
Middle Missouri	10.0	10.0	10.0	10.0	0.0
TOTAL	324.0	324.0	324.0	324.0	0.0
RECREATION					
Headwaters	-30.6	-0.1	-14.9	-0.1	0.0
Upper Missouri	-25.2	-4.0	-10.4	0.0	0.0
Marias/Teton	-4.2	-0.3	-1.1	0.0	0.0
Middle Missouri	-18.3	-2.0	-7.4	0.0	0.0
TOTAL	-78.3	-6.4	-33.7	-0.1	0.0
HYDROPOWER PRODUCTION					
Headwaters	-2.1	0.0	-1.0	0.0	0.0
Upper Missouri	-45.9	-5.2	-16.7	0.0	0.0
Marias/Teton	0.0	0.0	0.0	0.0	0.0
Middle Missouri	-34.4	-3.1	-13.6	0.0	0.0
Downstream	-107.9	-12.4	-45.3	-0.1	0.0
TOTAL	-190.3	-20.8	-76.6	-0.1	0.0
INCREASED POWER LOAD					
Headwaters	-6.3	-0.1	-4.5	-0.1	0.0
Upper Missouri	-7.0	-2.5	-2.7	-1.5	0.0
Marias/Teton	-7.6	-0.4	-1.5	-0.1	0.0
Middle Missouri	-17.2	-5.3	-12.5	0.0	0.0
TOTAL	-38.1	-8.3	-21.2	-1.8	0.0
TOTAL	151.3	327.2	305.1	322.0	0.0

[a] Positive numbers represent net benefits and negative numbers represent net costs. All figures are the value today of 70 years of future impacts based on a 4.6 percent real discount rate.

[b] This table replaces Table 7-1 in the draft EIS.

Reduced Hydropower Production

Reduction of streamflows would reduce power production at dams in the Missouri River basin under all but the Water Quality Alternative. Annual losses of hydropower production under each alternative are shown in Table 2-3. Table 2-3 shows the present cost of replacing 70 years of lost generation under the five alternatives at a 4.6 percent real interest rate. These values range from $190.3 million under the Consumptive Use Alternative to $120,000 under the Municipal Alternative. No replacement costs from hydropower production would occur under the Water Quality Alternative. As explained on page 144 in the draft EIS, the cost of replacement power is likely to rise over time. The values in Table 2-3 are therefore conservative.

Table 2-4. Reductions in annual value of recreation due to change in average flows (rounded to nearest 1,000 dollars)[a]

Alternative/ Subbasin	Flow reductions during July and August	Flow reductions during rest of year	Total
Consumptive Use			
Headwaters	$1,375,000	$ 92,000	$1,467,000
Upper Missouri	$ 965,000	$244,000	$1,209,000
Marias/Teton	$ 174,000	$ 26,000	$ 199,000
Middle Missouri	$ 731,000	$147,000	$ 878,000
TOTAL			$3,754,000
Instream			
Headwaters	$ 2,000	$ 1,000	$ 3,000
Upper Missouri	$156,000	$37,000	$ 192,000
Marias/Teton	$ 14,000	$ 3,000	$ 17,000
Middle Missouri	$ 78,000	$17,000	$ 95,000
TOTAL			$ 307,000
Combination			
Headwaters	$670,000	$42,000	$ 712,000
Upper Missouri	$398,000	$99,000	$ 497,000
Marias/Teton	$ 45,000	$ 6,000	$ 51,000
Middle Missouri	$297,000	$59,000	$ 355,000
TOTAL			$1,616,000
Municipal			
Headwaters	$ 2,000	$ 1,000	$ 3,000
Upper Missouri	-0-	$ 1,000	$ 1,000
Marias/Teton	-0-	-0-	-0-
Middle Missouri	-0-	-0-	-0-
TOTAL			$ 4,000
Water Quality			
Headwaters	-0-	-0-	-0-
Upper Missouri	-0-	-0-	-0-
Marias/Teton	-0-	-0-	-0-
Middle Missouri	-0-	-0-	-0-
TOTAL			-0-

[a] This table replaces Table 6-42 in the draft EIS.

NEW SUPPLIES FOR MUNICIPAL AND IRRIGATION POWER USE

DNRC's economic analysis used the present electric power rates in calculating costs of proposed irrigation and municipal projects. As explained in Chapter Six of the draft EIS, the cost of supplying this additional power would be higher than the current rates. The annual difference between the cost of additional power for proposed projects and what applicants would pay for power is shown in Table 2-2. Table 2-3 shows the cost of the subsidy that the ratepayer would pay over 70 years. It would range from $38.1 million under the Consumptive Use Alternative to $1.8 million under the Municipal Alternative. None of these costs would be incurred under the Water Quality Alternative. Power costs are likely to rise over time, so these values are conservative.

COMPARISON OF BENEFITS AND COSTS

Table 2-3 shows costs and benefits associated with the five alternatives. All but the Water Quality Alternative would increase consumptive uses, and would therefore result in lower streamflows for recreation and power production, and require additional replacement power use by irrigation and municipal water systems. The net benefits are highest in the Instream Alternative and lowest in the Water Quality Alternative.

As stated earlier in this section, this analysis is general because actual costs and benefits cannot be known until after the Board determines which reservations are to be granted. From this general analysis, however, several conclusions can be made. The large benefits derived from municipal water consumption are attributable to the high value of water for such a use and the small effect that withdrawals would have on other downstream uses, including hydropower production. The high costs for the Consumptive Use Alternative are due to the large amounts of water consumed by irrigation projects and the relatively small return in net benefits. However, comparison of the quantified values of the Instream Alternative and the Municipal Alternative clearly shows that at least some proposed irrigation projects can have net benefits to society. Finally, any of these alternatives would have more net dollar benefits than the No Action Alternative or the Water Quality Alternative.

BENEFITS AND COSTS OF GRANTING RESERVATIONS FOR INDIVIDUAL PROJECTS

A reservation for future consumptive use would have benefits because it would help ensure that water would be available for development of a productive irrigation or municipal use. A reservation for instream flows would have benefits because it would provide legal protection for fish, wildlife, recreation, and water quality. In both cases, granting a reservation imposes costs because it may preclude other uses of reserved water. The benefits of granting a reservation exceed the costs if the value of the water in its proposed use is greater than its value in uses that would be precluded by the reservation.

All of the consumptive requests have at least potential competing uses. Many streams have two or more consumptive use requests, and in some cases there is not enough water to satisfy all proposed reservations. All the consumptive requests compete with instream requests, either on the stream reach where the water is being requested, or downstream. Consumptive use requests on a tributary also can compete with other consumptive use requests and existing hydropower uses downstream. Instream requests can compete with consumptive use requests on the same stream or on tributaries upstream.

On 239 stream segments, reservations were requested for both instream and consumptive uses. When two reservation requests cannot both be granted because they compete, the cost of granting one request is the value of the foregone benefits of the other. On streams with three or more requests, the net benefits will be greatest from granting as many requests, starting with the highest valued, for which there is water.

Table K-4 in Appendix K in the draft EIS compared competing consumptive use values with instream values. This information has been revised and is included in Appendix B. The values of water estimated in the draft EIS used one set of assumptions. Commenters requested DNRC to determine how sensitive the results of the analysis in the draft EIS are to changes in this set of assumptions. Assumptions regarding variables that influence the value of water for irrigation and replacement power have been changed as follows.

The consumptive use values for irrigation were derived using three different assumptions. Method No. 1 (indicated in the second column of Appendix B) assumed that 50 percent of the water diverted would return to the source. This assumption would overestimate the value of proposed irrigation that would use efficient sprinkler systems, while underestimating the value of projects with less efficient flood irrigation systems. Method No. 2 (the third column of Appendix B) estimates the amount of water consumed for each project by taking into account annual diversions as estimated in the conservation district applications, irrigation system efficiencies for each project and other losses, and assumes that 10 percent of the return flows would come back to the stream after the irrigation season. Method No. 3 (the fourth column of Appendix B) uses estimates of water consumed by each project as estimated by DNRC's Missouri River water availability model. The model considers crop water requirements and irrigation efficiencies for each subbasin as described in Appendix C of the draft EIS. Both methods No. 2 and No. 3 included the further assumption that there would be no return flows for 65 proposed irrigation projects located on higher benchlands. Of these methods, DNRC believes method No. 3 provides the most reasonable estimates.

The cost of replacement power was estimated based on two different values, 50 and 100 mills (5 and 10 cents) per kWh. This affected the replacement power costs associated with reductions in hydropower production and increased electrical power loads. It should be noted that the costs attributed to increased power loads were not included in the draft EIS's consumptive use values, but are accounted for in this analysis in Appendix B. The instream flow values that are a summation of the recreational and hydropower values also are impacted by the cost of replacement power. The difference is in the hydropower values. Further, hydropower values in this analysis are specific to dam location rather than by subbasin. The recreational values are the same as those in the draft EIS. The value of water for instream uses is shown in Tables 2-5 and 2-6.

At least 10 and as many as 59 of the 219 proposed irrigation projects would have a value per acre-

Table 2-5. Recreation values per acre-foot at 1989 flows

Subbasin	July-August	Rest of Year
Headwaters	$35.40	$8.23
Upper Missouri	$19.46	$4.76
Marias/Teton	$ 5.81	$1.63
Middle Missouri	$ 5.81	$1.63

Table 2-6. Hydropower values per acre-foot

Subbasin/dams	Value @ 50 mills	Value @ 100 mills
Headwaters Subbasin above Toston	$58.91	$117.83
Upper Missouri Subbasin		
Toston Dam to Canyon Ferry Dam	$56.88	$113.76
Canyon Ferry Dam to Hauser Dam	$51.81	$103.61
Hauser Dam to Holter Dam	$49.98	$ 99.96
Holter Dam to Morony Dam	$46.02	$ 92.05
Marias/Teton Subbasin and Middle Missouri Subbasin		
Morony Dam to Fort Peck Dam	$33.36	$ 66.72

foot of water that is greater than the value of water used for instream purposes, given a 5 cent/kWh power cost (Appendix B). The value of water for at least 1 and as many as 4 of the proposed irrigation projects would be greater than the value of water used for instream purposes, given a 10 cent/kWh electricity cost. The estimated value of an acre-foot of water for all municipal reservations exceeds the estimated value for instream flow and proposed irrigation projects. Instream flow values are greatest in the headwaters subbasin, where the recreation value is the highest and where each acre-foot of water can be passed along to be used to generate hydroelectricity at downstream hydropower facilities. Instream values decline progressively with distance downstream, but the value of water for irrigation remains more consistent throughout the basin.

REASONABLE ALTERNATIVES WITH GREATER NET BENEFITS

As stated in the draft EIS, the alternatives presented in this final EIS represent only several of many ways the Board could act on the reservation applications. Some other combination of reservations probably would have greater net benefits than any of the five alternatives examined by DNRC. DNRC did not attempt to determine an optimal alternative, but instead provided a range of alternatives to assist the Board in its evaluation of relative costs and benefits from the reservation requests.

CHAPTER THREE

COMMENTS, RESPONSES, AND CHANGES TO THE DRAFT EIS

INTRODUCTION

This chapter presents DNRC's responses to public comments on the draft EIS. Changes to the draft EIS also are included in this chapter.

A 60-day comment period that began July 3, 1991, was extended an additional 14 days and ended September 16, 1991. Ten informational meetings and public hearings were held from August 5 through 8, 1991, to take comments on the draft EIS. Table 3-1 lists the locations of these meetings, the number of people attending, and the number of people making formal comments.

The following list includes the names of individuals who made oral comments on the draft EIS at the public hearings:

Rich Day
B. Miller
Charles Swysgood
J.B. Anderson
D. Moss
Monte Clemow
B. Holdorf
D. Bryant
Stan Bradshaw
K. Stensva
Alvin Hensvold
Mark Solmosky
Betty Jo Bergin
Claria Spek
Dianne McDermand
Jack Humphry
A. Miller
J. Ramirez
M. Doken
W. Stender
R. Smith
Ray Tilman
R. Gosman
Dick Kennedy
Tony Schoonen
M.O. Spec
Tim Brunner
Gordon Ekland
William Bergin
John Rouanne
Boettger
Fry

The following list includes the names of individuals or organizations that submitted written comments to DNRC on the draft EIS:

Pat Simmons and Dick Krawiec, Gallatin Gateway
David Sali
Betty Humbert, Twin Bridges
Erling Tufte, Director, Public Works Department, City of Great Falls
Peter Lesica, University of Montana
M. Chris Imhoff, Helena
William "Blondy" Patrick, President, Skyline Sportsmen's Association, Butte
Jim Peterson, President, American Fisheries Society, Great Falls
William Howell, President, Town Council, West Yellowstone
Joe Gutkoski, Bozeman
Monte J. Boettger, City Attorney, Lewistown
Dr. John P. Humphrey, Lewistown
Wayne Turner, Jackson
Sharon Turner, Jackson
Paul F. Berg, Chairman, Legislative Committee, Southeastern Montana Sportsmen Association, Billings

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Table 3-1. Public participation in hearings held to take comments on draft EIS

Hearing location	Number of people attending	Number of people making comments on draft EIS
Helena	13	3
Roundup	10	9
Big Sandy	2	0
Great Falls	13	2
Ennis	2	0
Valier	7	1
Lewistown	12	3
Bozeman	29	3
Glasgow	9	0
Dillon	101	14

Gunnar and Elaine Kalsta, Glen
J. Blaine Anderson, Jr., Attorney at Law, Dillon
Max A. Hansen, Max A. Hansen & Associates, P.C., Dillon
Andy Epple, Planning Director, City-County Planning Office, Bozeman
Phillip J. Forbes, Director of Public Service, Bozeman
Tom R. Johnson, Chairman, Glacier County Conservation District, Cut Bank
Margie and Harold Petersen, Wisdom
Walter A. and Louise Steingruber, Willow Creek
Monte Clemow, Chairman, Headwaters RC&D Ag Water Committee, Butte
Mike Wendlan, Chairman, Hill County Conservation District, Havre
Randall P. Smith, Glen
Bill Davison, President, Garrison Ranches Inc., Glen
Donald P. Taylor, Wicks Ranch Corporation, Lewistown
Jim L. Wedeward, Project Manager, U.S. Bureau of Reclamation, Montana Projects Office, Billings
Bernard J. Harkness, Dell
Jennifer Smith, President, Madison/Gallatin Chapter Trout Unlimited, Bozeman
Joy Reeder Wicks, Secretary/Treasurer, Wicks Ranch Corporation, Lewistown
Dianne L. McDermand, Vice-President, Medicine River Canoe Club, Great Falls
Richard H. Kennedy, East Bench Unit, Dillon
George Wold, Butte
Ben C. and Faye F. Holland, Dillon
Robert Van Deren, President, Beaverhead County Farm Bureau, Dillon
Charles W. Proff, Chairman, Teton County Conservation District, Choteau
Tony Schoonen, Dillon
Robert A. Sisk Jr., Galata
Charles Hahnkamp, Cherry Creek Angus Ranch, Melrose
Eva Stanford, Stanford Ranch, Dell
James Binando, Acting Deputy State Director, Division of Lands and Renewable Resources, U.S. Bureau of Land Management, Billings
James Coffman, Public Works Director, Chester
Gary L. Spaeth, Spaeth Law Firm, Joliet
Barry T. Wharram, Chairman, Chouteau County Conservation District, Fort Benton
Edward F. Arnott, Steve Halstrom, Larry Hodge, David Kohn, John Metcalf, Gerald Evans, Judith Basin Conservation District, Stanford
Douglas H. Parrott, President; Frank Goffena, Henry Bedford, Robert Goffena, directors; Walter Newton, Secretary; Deadman's Basin Water Users Association
Sue M. Olson, Chairman, Musselshell County Commissioners, Roundup
Vernon Petersen, Chairman, Fergus County Commissioners, Lewistown
Frank Goffena, Vice-Chairman, Lower Musselshell Conservation District, Roundup
Lloyd Berry, Secretary, Upper Musselshell Conservation District, Harlowton
Vernon R. Ballard, Chairman, Golden Valley County Commissioners
Sally J. Armstrong, Mayor, Roundup
Carl M. Davis, Schulz, Davis & Warren, Dillon
Holly J. Franz, Gough, Shanahan, Johnson & Waterman, Helena
Peggy L. Parmelee, Executive Vice-President, Montana Association of Conservation Districts, Helena
M.K. Botz, Hydrometrics, Helena
Leah Stanford, Dell
Dixie Nugent, Administrative Secretary, Cascade County Conservation District, Great Falls
Mark Clemow Jr., Mark Clemow Ranches Inc., Wisdom
Edi Hodges, Administrative Secretary, Liberty County Conservation District, Chester
Hugh Zackheim, Helena
Kathy Hadley, President, Montana Wildlife Federation, Bozeman
Elsie Laden, President, and Charles Laden, Beaverhead Seven Up Ranch, Dillon
Jo Brunner, Executive Secretary, Montana Water Resources Association, Helena
John W. Mumma, Regional Forester, U.S. Forest Service, Missoula
Gary Enneberg, Chairman, Toole County Conservation District, Shelby
Marge Jappe, Chairman, Beaverhead People for the West, Dillon
Walter Van Deren, President, Open A Ranch Inc., Dillon
Dorothy Stout, Sheridan
Ole M. Ueland, Silver Bow
Robert Lane, Supervisor, Gallatin Conservation District, Bozeman
Stan Bradshaw, Resource Director, Trout Unlimited Montana Council, Helena
Peter J. Chamberlain PhD, Benton City, Washington
Liter Spence, Water Resources Supervisor, Fisheries Division, Department of Fish, Wildlife and Parks, Helena

COMMENTS AND RESPONSES

The following pages present written and oral comments and DNRC's responses to them for each resource type. To avoid duplication, similar comments made by several parties were combined and answered only once. In some cases, the response to a comment is shown merely as "comment noted." This means either that DNRC acknowledges the comment, or that the comment is the opinion of the commenter. Changes and corrections to the draft EIS are shown at the end of this chapter.

LEGAL CONCERNS

WATER AVAILABILITY

1. **Comment:** The basic fallacy of the entire water reservation process is the presupposition that water is legally available for appropriation. Granted, there may be legally available water at times when the demand for consumptive use of water is low and the demand for instream flows is low. Unfortunately, the demand for consumptive use of water—i.e., irrigation—and the demand for instream flows occur at the same point, usually June through September. It appears from a review of the draft EIS and tables contained in it that applicants for reservations concluded that water is legally available for reservation appropriations by averaging monthly streamflows. The fallacy of this is that when high monthly flows occur, usually during May and June, there is a low demand for consumptive use of the water, and any instream flow demand is satisfied by high runoff water.

Response: No presumption is made in the water reservation process that water is legally available for appropriation. The reservation statute, § 85-2-316, MCA, requires that all water users who may be affected by reservations be given notice and provided with the opportunity to object to water reservation applications. A contested case hearing must follow, with the hearings examiner submitting findings of fact and conclusions of law to the Board for its use in reaching a decision on the reservation applications. The methods used by the applicants to determine their reservation requests are outlined in Chapter Three of the draft EIS. The applicants did not use average monthly streamflows to determine that water was legally available for their reservations; no such statement appears in the draft EIS.

Consumptive use demands generally are highest during the summer and early fall. Not only have applicants requested instream flows for these times, but also for throughout the entire year.

2. **Comment:** The draft EIS fails to show the availability of unappropriated waters on the stream sources required by § 85-2-308, MCA, or how to deal with the fact that requested flow rates are far in excess of available water.

Response: Section 83-2-308, MCA, sets out the procedure for objections to permit applications and reservation applications. The criteria the Board will use in making decisions regarding water reservation applications are found in § 85-2-316. See response to comment 3 regarding water availability.

3. **Comment:** Can a water reservation be issued when the water is not always available?

Response: The water reservation statutes do not require that water always be available in order for the Board to grant a reservation. The applicants, however, are required to submit an analysis of the physical availability of flows for their water reservation requests (ARM 36.16.105B). Data on the physical availability of flows for the reservation requests also were provided in appendices C and D of the draft EIS. The contested case hearing will provide the forum for the Board to determine whether reservation applications would have adverse effects on existing rights.

4. **Comment:** Irrigators are starting to use water from the Musselshell River during March and April when water quality is better. If DFWP obtains an instream flow reservation, will this water be available for irrigation? Will the reservations for instream flows affect our [Musselshell Water Users] ability to use our contract water from storage and to divert water from the Musselshell River and tributaries before May 1?

Response: The priority date for contract water from Deadman's Basin Reservoir is June 5, 1934, which is senior to that of any reservation. Reservations granted to DFWP could not affect the availability of this contract water.

DFWP is requesting 80 cfs instream flows in the Musselshell River from its head to the Musselshell diversion between Musselshell and Melstone, and 70 cfs from the Musselshell diversion to the mouth. Figures 3-1 and 3-2 show monthly percentile exceedance flows for the Musselshell River at Harlowton and Mosby. Flows in the Musselshell River near Harlowton are below the 80 cfs requested by DFWP during the 2 driest years out of 10 in April. In May, flows at Harlowton are below 80 cfs during the driest 1 year in 10. At Mosby, average flows in April and May are below 70 cfs during the driest 1 year in 10. Because flows in the Musselshell River are sometimes below those requested by DFWP in the spring, water from the Musselshell River and many tributaries would not be available for new appropriation in the spring of some years if DFWP's reservation requests are granted in full. Contracts for water in Deadman's Basin Reservoir are valid from May 1 through September 30.

5. **Comment:** We [Skyline Sportsmen's Association, Inc.] are opposed to the Consumptive Use, Combination, and No Action alternatives for the following reason: The Missouri River basin already is overappropriated, with irrigation now controlling 97 percent of the public water.

Response: Your opposition to the referenced alternatives is noted. In the Missouri basin, a large amount of water is claimed for irrigation, but hydropower claims also are extensive.

Figure 3-1. Average monthly flows in the Musselshell River at Harlowton

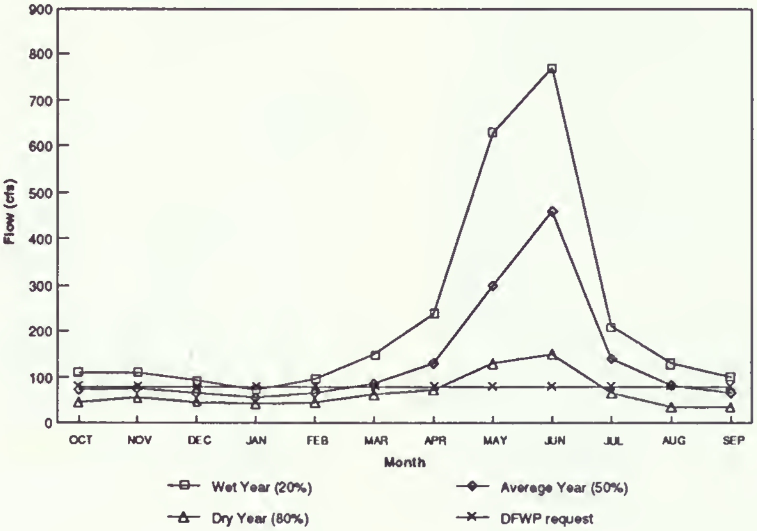
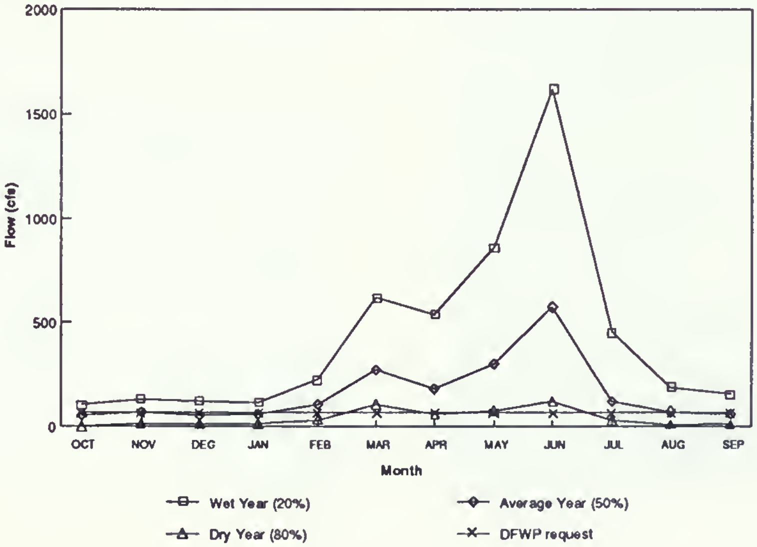


Figure 3-2. Average monthly flows in the Musselshell River at Mosby



6. **Comment:** The existence of water rights and use permits and upstream and downstream reaches, including recharges, offstream storage, supplemental flows, etc., inherently maintain varying degrees of flow that contribute to the instream flow needs identified by DFWP and DHES. The levels of these flows and the amount contributed to their identified needs could be subtracted from the reservation requests and still offer a significant contribution to the need.

Response: When a shortage occurs, senior water rights—those with a priority date before July 1, 1985—would be satisfied before the water reservations. Return flows from existing irrigation and releases from storage would, in some instances, help satisfy the instream flow requests of DHES and DFWP. It is important to remember, however, that existing water users with claims and permits before July 1, 1985, still would have priority over the instream reservations. Instream reservants would be "riding the coattails" of existing water right holders and would share the same water until a shortage occurs. When a shortage occurs, senior water rights—those with a priority date before July 1, 1985—would be satisfied before the water reservations.

7. **Comment:** On page 4 of the draft environmental assessment for the City of Belgrade, DNRC states: "Discussions with Bozeman water resources regional office personnel (Compton and Mack 1989) suggest that water for the reservation is physically and legally available." This statement appears to contradict the draft EIS, which shows an absence of unappropriated water above Morony Dam. Please explain.

Response: According to the Missouri River water availability model, some water is in excess of existing claims during some years and during some months. Please refer to pages 57 and 59 and Table 4-10 (p. 58) in the draft EIS for specific time periods. Nowhere in the draft EIS is the conclusion reached that no water is available for appropriation.

8. **Comment:** On pages 23-28, we [BUREC] note that some of the requested flows exceed the "50 percent of the average annual flow of record" limit set by § 85-2-316(6), MCA.

Response: In Table 5-1 of the draft EIS (p. 135), instream flow requests that exceed half the average annual flow of gauged streams are identified and reduced to half the average annual flow.

9. **Comment:** How will the Board know how much water is available for instream flow reservations when the adjudication process is not complete?

Response: Montanans have been appropriating and using water without a completed statewide adjudication since the late 19th century. In 1973, the Montana Legislature initiated an adjudication of existing water rights and two processes for issuing new water rights, water reservations, and provisional water use permits. Chief Water Judge C. Bruce Loble (Loble 1991) estimates that the adjudication will take at least 15 more years to complete. The Board must reach its decision on water reservation applications by July 1, 1992.

Under the prior appropriation doctrine, the proposed instream reservations would not affect existing water rights with a priority date earlier than July 1, 1985. As with provisional water use permits issued throughout the past 20 years, these reservations recognize and cannot adversely affect senior water rights.

10. **Comment:** Previously adjudicated (decreed) streams do not have water available for instream flow reservations.

Response: Regardless of the decreed status of a stream, prospective water users have a continuing right to apply for water reservations. Even if a stream is decreed, further appropriations through water reservations are possible if the criteria for issuing a reservation are met. If the stream is not closed to appropriation, the Board is obligated by law to process applications for reservations. Existing water right holders who feel that their water use may be adversely affected can object to proposed new uses under reservations.

11. **Comment:** The draft EIS states on page S-3: "The exact amount of water legally available for future consumptive appropriation, if any, will not be known for some time." This statement begs the question. If instream flow reservations are granted in the amount and during the time requested, there will be no future appropriation for consumptive uses. Any attempt to reduce instream flows, once granted, will surely result in lengthy litigation.

Response: This statement is included in the draft EIS primarily because the large instream water right claims held by MPC and BUREC have not been adjudicated. If these rights are adjudicated as claimed, and if it can be demonstrated that additional water use would cause adverse impacts on these rights, little water may be available for future appropriation, regardless of Board action. In most cases, instream flow reservation requests are considerably less than hydropower water rights claimed by MPC and BUREC. Further, the large instream water right claims of BLM for the wild and scenic river stretch of the Missouri and the U.S. Army Corps of Engineers' hydropower claims at Fort Peck could limit water availability in the mainstem Missouri and tributaries above Fort Peck Reservoir.

12a. **Comment:** One of the arguments for passage of the 1979 adjudication law was that most streams, like the Beaverhead, were overappropriated and water was not available to satisfy existing water rights. If sufficient water were available, the water users and BUREC would not have constructed the Clark Canyon Dam or the state its storage projects.

12b. **Comment:** The draft EIS is based on the assumption that water is available to reserve. We already are overappropriated on many streams, including the Red Rock/Beaverhead and the Big Hole.

Response: The adjudication statute was passed in 1973 (amended in 1979) to systematically quantify and determine water rights in existence prior to 1973. Before then, Montana had no formalized statewide process to determine the quantity of existing water rights.

The reservations are based on the prior appropriation doctrine. The reservants—as with all other water users—can use water only when it is available.

PRIORITY DATES

13. **Comment:** If more than one department or municipality asks for a July 1, 1985, reservation, who has priority?

Response: The Board will establish the priorities among reservations it grants within that date (July 1, 1985) as required by statute (§ 85-2-331 MCA).

14. **Comment:** What happens to provisional water use permits issued after July 1, 1985?

Response: See page 7 of the draft EIS.

15. **Comment:** How would instream flow reservations affect irrigation water rights in existence before July 1, 1985?

Response: The amount of water used under water rights in existence before July 1, 1985, would not be affected. Under Montana law, a reservation cannot be granted if the record of the contested case hearing shows that the use of senior water rights would be adversely affected. If granted, the instream flow reservations requested by DFWP would be junior to all pre-July 1, 1985, water rights.

16. **Comment:** Would the granting of reservations affect uses after July 1, 1985?

Response: Appropriation of water after July 1, 1985, would be junior to any water reservation granted. Granting water reservations could leave less water available for future appropriation and use, with the amount of water varying by stream. Refer to page 7 of the draft EIS for a discussion of the effect of reservations on provisional water use permits issued between July 1, 1985, and the date the Board makes its decision on the reservation applications.

17. **Comment:** The Montana Legislature set a July 1, 1985, priority date for the reservations. What's to stop the legislature from setting an 1885 or 1785 priority date for reservations?

Response: The Montana Legislature has never attempted to retroactively establish an earlier priority date for water rights and may not have the authority to do so.

18. **Comment:** Although those with old water rights are not supposed to be affected by these reservations, it appears that the old water right holders still may be forced to go to court to use their rights in drought years.

Response: During times of shortage, senior water rights are entitled to receive water before junior rights. If senior water right holders are not getting the water to which they are entitled, they may seek a remedy in district court.

19. **Comment:** As noted on page 254 of the draft EIS, DNRC did not examine the effects that the reservation applications would have on water use permits issued since 1985. We [Deadman's Basin Water Users Association] recommend that these effects be analyzed. We also recommend analysis of those permit requests filed but not yet acted upon before the Board makes its reservation decisions. All of

those permits and requests could cumulatively amount to a significant measure of benefit, especially if they are subordinate to pending reservation requests. This would not be significant if the reservation process could have been concluded in a short time instead of seven-plus years.

Response: DNRC notified all holders of provisional permits issued after July 1, 1985, that their permits would be junior to any water reservation applications granted by the Board. Permits and permit applications issued or applied for before July 1, 1985, are summarized by subbasin and major drainage in Appendix A. More than 400 post-1985 permits and permit applications would be junior to reservations unless the Board subordinates reservations to them. The Board may subordinate a reservation to a permit if it finds that the subordination would not interfere substantially with the purpose of the reservations. Because the Board could subordinate the reservations to some, none, or all of these permits, it is not possible at this time to analyze the effects that reservations would have on these permits.

20. **Comment:** I [George Wold] have a ranch at 160 District Duncan Road in Sheridan, Montana. This ranch is on Mill Creek. I am dependent on Mill Creek water for irrigation and storage water. Mill Creek was measured at the Forest Service boundary above any user turnouts. This impact statement proposal will leave all irrigators without water except during the high-water season.

Response: Assuming your water right permit or claim is before July 1, 1985, the instream flow water reservation—if granted—would be junior to your right. You would be able to use your existing water right as you have in the past.

21. **Comment:** We [Robert A. Sisk, Jr.] are writing this letter with concern over the possible loss of our water service contract. These water rights are essential to our farming and ranching operations on the Willow Creek arm of Lake Elwell. Without the water, the irrigation system we currently have would be useless. We live in a dry area, and our only hay production is under irrigation. Having spent more than $300 per acre on the irrigation system, a loss of this enterprise would be detrimental to our ranching operations and financial stability. We definitely would be against any ruling that would reduce our water availability.

Response: Your water service contract with BUREC for water from Lake Elwell has a priority date before July 1, 1985. Therefore, no reservation would affect your ability to use this water.

LEGAL STANDING FOR INSTREAM FLOWS

22a. **Comment**: Granting instream flow requests will give DFWP standing to object to new uses and changes in use. Additionally, an instream flow reservation appropriation grants the appropriator legal standing to sue. The net result is that any activity contemplated on the stream, such as installing a new diversion system, may be delayed unreasonably due to objections by the instream flow reservants.

22b. **Comment:** The instream flow reservations will provide DFWP with legal objector status during the adjudication of existing water rights. They will be able to use this standing against existing water right holders. Existing water right holders will be required to put up a legal defense to protect their valid, existing water rights against DFWP, DHES, and BLM. The resources of an existing water right holder are no match for DFWP, DHES, or the United States government. This mismatch in size will allow these agencies to take existing water rights by exhausting the resources of existing water right holders. We are opposed to this situation.

Response: DFWP believes it already has standing in the adjudication process and has objected to a number of claims in the Missouri River basin above Fort Peck Dam. DFWP also feels that it has standing to object to new permits and changes in use in these same areas. DNRC, however, has not allowed DFWP to have standing on streams to contest new uses or changes in use unless DFWP could show it has water rights that would be affected. If the Board grants DFWP's requested reservations, DFWP would gain legal standing to object to new uses and changes in use in more streams in the Missouri River basin above Fort Peck Dam. DFWP would be required to follow the same objection process as any other water right holder. For its objection to be upheld, DFWP would have to show that its reservations would be adversely affected. See page 179 of the draft EIS.

23. **Comment:** On page 179, column one, fourth paragraph, the discussion of legal standing with reservations is true only if the government entity applying for a reservation doesn't already have standing to object. DFWP's existing rights (pre-1973) such as

Murphy rights provide standing for objecting to changes and new permits in a number of drainages. The draft EIS suggests that a reservation will give DFWP first-time standing to object in the adjudication process that is addressing pre-1973 water rights. Existing statutes and the fact that DFWP is a pre-1973 water right holder in many basins already give DFWP standing in the adjudication process. This standing is independent of any reservation that may be granted. There is a misconception that DFWP will now acquire standing in the adjudication process if it receives reservations, whereas in many instances DFWP already has such standing.

Response: In many instances, DFWP already may have standing to object to new permits and in the adjudication process. The draft EIS points out that a water reservation is an appropriation of water. Appropriators acquire standing to object in proceedings that may affect the exercise of their water rights. Standing also may be created by other situations, however, such as holding another type of water right, or it can be authorized specifically by statute.

24. **Comment:** If DFWP obtains a reservation with a 1985 priority date, it may have little effect on instream flows but would give DFWP standing to become involved in the daily operation of every stream and river in the state at great expense to the public and the water users with rights prior to 1985.

Response: An instream flow reservation would give DFWP additional standing in a water right proceeding only if it does not already have standing. It is not known whether DFWP would become involved in the daily "operation" of every stream for which it has applied for a reservation.

25. **Comment:** If a reservation is granted to DFWP, it [DFWP] should not have the legal right to object to requests of existing water right users to change their places of diversion, places of use, or storage, if DFWP's right with a 1985 priority date is clearly not affected. These matters are governed by DNRC under existing law and rules to safeguard the public without adding another department to the process.

Response: Montana statute provides that an appropriator may make a change in the place of diversion, the place of use, the purpose of use, or the place of storage if the appropriator proves, in part, that the change will "not adversely affect the water rights of other persons or other planned uses or developments . . . for which water has been reserved" (§ 85-2-402(2)(a), MCA). DFWP would be required to follow the same objection process as any other water right holder. For its objection to be upheld, DFWP would have to show that its reservation would be adversely affected.

GENERAL

26. **Comment:** The draft EIS does not fulfill the requirements for an environmental impact statement. There are few, if any, definitive conclusions on how any given action would affect the environment or on water usage in the basin.

Response: The draft EIS does meet the requirements of an EIS under MEPA. The draft EIS describes the existing environment in the upper Missouri River and identifies the impacts or possible impacts of granting or denying all or some of the reservation requests. Because of the large number of applications and the diversity of beneficial uses applied for, the draft EIS analyzes a range of alternate Board actions. Since the authority to grant or deny water reservation applications rests with the Board, the EIS is not a decision-making document. Nor does the EIS identify a preferred alternative or make any conclusions as to whether any applicant has met the criteria for the Board to grant a reservation. The EIS only presents facts, information, and known or potential impacts for the Board to consider in making its decision.

27. **Comment:** There is no statement of cost as required by state law on the draft EIS. All state agencies are supposed to show the cost of preparing, printing, and distributing a document. Who is responsible for this, and what will be done to correct this situation? How much did the EIS cost, and why was it not sent to all potentially affected parties?

Response: DNRC made an error in not disclosing printing and distribution costs as required by law. One thousand copies of the draft EIS were printed at a cost of $12,324.28, or about $12.32 per copy. It cost approximately $1.91 to send each copy in the mail. This amount added to the printing cost totals $14.23 per copy. The reservation requests could affect many Montanans—users of electricity, irrigators, and recreationists, to name a few. If the draft EIS were sent only to existing water right holders, the cost would exceed $170,000. Because of this cost, the EIS was not sent to all potentially affected parties. Instead, DNRC published notice of the availability of the draft EIS three times in 11 newspapers of general circulation in the basin and sent copies to everyone who requested them. Additional copies were sent to local libraries. Also see response to comment 280.

28. **Comment:** Overall, what has been presented as an EIS does not meet the requirements. The purpose of an EIS is to analyze a major action to determine its impact on the environment. Certainly, the reservation of water basinwide meets the requirement of a major action. However, the analysis rarely comes to any definitive conclusion on environmental impact. The basic intent in the draft EIS, it seems, is to assemble water reservation requests submitted by various government bodies and propose to the Board a course of action it should follow. There is no problem in an EIS summarizing facts and figures. There is, however, a difficulty in not outlining specific environmental consequences based on that summary and in trying to direct policy decisions through the EIS mechanism.

Response: The draft EIS does not propose a course of action to the Board.

29. **Comment:** The draft EIS fails to adequately consider or discuss the cumulative effect of the numerous reservation applications on prior existing appropriated rights and the need or ability to appropriate water for future consumptive use.

Response: By statute (§ 85-2-316), water reservations cannot adversely affect water rights in existence before July 1, 1985. This is addressed on page 175 of the draft EIS. The effects that reservations could have on permits issued between July 1, 1985, and the date the Board makes its decision are discussed on page 179. Also discussed on page 179 are the amounts of water that would be available for future appropriation if reservations are granted.
Public entities were given the opportunity to submit applications to reserve water for future consumptive use. Eighteen conservation districts, 18 municipalities, and BUREC submitted applications for this purpose.

30. **Comment:** Any reservation granted to DFWP should specifically preclude DFWP from having standing to put a water commissioner on any river or stream at the expense of the water users with prior rights.

Response: DFWP could not petition for the appointment of a water commissioner under present decrees. Under § 85-5-101(1), MCA, the district court may appoint a water commissioner "upon the application of at least 15 percent of the water rights affected by the decree." Since any water reservation awarded to DFWP would not be included in the existing decrees, DFWP would not have a right affected by the decrees and therefore could not petition. Even though DFWP cannot request appointment of a water commissioner without being included in a decree, if a commissioner is appointed by petition from other water users, DFWP probably would be required to help pay for the commissioner if DFWP's water reservation right is distributed by the commissioner.
After an enforceable decree is entered by the Water Court under the adjudication process, a water commissioner may be appointed by the district court upon application by DNRC and one or more water right holder(s), which would include water reservants. Once appointed, the water commissioner would distribute water to all appropriators, including water reservants, according to their rights and priorities.

It is not known whether the Board has the authority to condition a water reservation specifically to preclude the reservant from petitioning for a water commissioner. This issue must be addressed by the Board.

31. **Comment:** The draft EIS fails to state the costs that have been and will be incurred in considering DFWP's application, what administrative plans DFWP has, and the costs that will be involved to administer its reservation, if granted.

Response: The costs of giving notice, holding the hearing, conducting investigations, and making records incurred in acting upon the applications to reserve water—except salaries—are paid by the applicants. A reasonable proportion of DNRC's cost of preparing an EIS also must be paid by the applicants. The total cost of the notice and contested case hearing paid by the applicants will be $194,724, of which DFWP will pay $82,626. The total cost of the EIS paid by the applicants is $278,250, of which DFWP paid $120,000. Although DFWP's management plan describes how reservations might be enforced if granted, DFWP has not identified the costs of administering its reservation.

32. **Comment:** On page 242 of the draft EIS, Table 6-50, DNRC identifies measures that could be

adopted to reduce impacts. To reduce conflicts between reservants and existing water users over available water, DNRC suggests the installation of measuring devices and the hiring of a water commissioner to monitor diversions and allocate water in accordance with water rights. If water is legally unavailable, as it is in the Missouri River basin above Morony Dam, consumptive water reservation applications must be denied. Because water commissioner fees are paid according to the amount of water received, existing water users—who will receive most of the water based on their priority dates—will be primarily responsible for paying the water commissioner's fees. It is unfair to put this additional expense on senior water users when unappropriated water is not legally available.

Response: The EIS suggests possible measures that could be adopted to reduce conflicts between reservants and existing water users over *available* water. Under the prior appropriation doctrine, senior water right holders exercise their rights first. To avoid controversy, a water commissioner sometimes is requested to distribute water according to priority.

33. **Comment:** The draft EIS fails to adequately describe existing or future beneficial uses planned in connection with the reservation as required by § 85-2-316, MCA.

Response: The types of beneficial uses allowed by law include, but are not limited to, agriculture (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses (§ 85-2-102(2)(a), MCA). The water uses planned by the reservation applicants are described in Chapter Three of the draft EIS.

34. **Comment:** We [Ben C. and Faye F. Holland] are opposed to the DFWP reservations because the applicant has failed to document with sufficient specificity that its reservations on gauged streams amount to 50 percent of baseline flow.

Response: The water reservation statute (§ 85-2-316, MCA) limits the Board to granting a maximum of 50 percent of the average annual flow of record on gauged streams for instream flow reservations. In Table 5-1 of the draft EIS (p. 135), instream flow requests that exceed this limitation are identified and have been reduced to meet the statutory limitation. The water reservation statute does not prohibit applicants from *applying* for instream flows that exceed this limitation, but the statute limits the amount the Board can *grant*. On some gauged streams, DFWP applied for instream flows that exceed half the average annual flow of record. DFWP identifies these streams on pages 1-30 and 1-31 of its reservation application (DFWP 1989).

35. **Comment:** Where in this document does it say that the government will not take my water rights?

Response: See the "Legal Water Availability" section of the draft EIS (p. 175).

36. **Comment:** DNRC will take over water rights.

Response: DNRC did not apply for a reservation and has no legislative authority to take over existing water rights under the reservation system.

37. **Comment:** The reservation process is complex, and an attorney is needed to protect water rights. In addition, the EIS doesn't mention the adverse financial impact of these reservations on senior water right holders, nor the cost in time and money that will be needed to defend existing water rights from water reservations.

Response: The reservation process is complex, and individuals will need to decide whether the reservations would affect any aspects of their existing water uses. The scope of the upper Missouri River water reservation proceeding and the process required to be followed were established by the legislature. See response to comment 38.

38. **Comment:** This EIS doesn't mention the adverse financial impact of these reservations on senior water right holders. The cost in time and money to defend an existing water right from water reservations should be cited.

Response: The time and money required to defend senior water rights will depend on the number of people who object to the proposed reservations and a water right holder's level of participation in the process. Time commitments and costs are not known at this time.

39. **Comment:** Could the U.S. Congress require Montana to allow a certain amount of water to meet the needs of downstream states?

Response: Water flowing from one state to another can be apportioned by Congress among the states.

40. **Comment:** Will the reservation process help keep water in Montana?

Response: According to Frank Trelease (Trelease et al. 1982), a noted western water law expert, the water reservation process is surpassed only by the actual development of water as the best means to protect water for Montana in an interstate proceeding to divide the waters of the Missouri River among the basin states. The strength of the reservation process is that it requires a contested case hearing; an EIS for assessing economic feasibility and environmental impacts; an identification of the point of diversion, place of use, and other relevant information for each project; and criteria for establishing due diligence in development of the water.

41. **Comment:** If there is future conflict between irrigation users and state agencies with reservations, who will decide the matter?

Response: Conflicts among water right holders are decided by the district court.

42. **Comment:** The Gallatin River is dewatered every year, and, in fact, a court case is now in progress over the Baker Ditch Company being cut off.

Response: Low flows are a problem in the lower Gallatin River during dry years, but they do not occur every year. There was a case in district court involving the Baker Ditch Company and diversions from the lower Gallatin River. This case was decided by the court [Baker Ditch Co. v. District Court, 48 St. Rep. 972 (Mont. 1991)].

43. **Comment:** The requested reservations are for flows of extremely high magnitude. It is not clear that enforcement of the priority system will provide sufficient protection for existing rights, given the scale of the requested reservations. The draft EIS does not adequately address this problem. It does not include sufficient information on how the reservations will affect the protection and continued use of existing water rights on each of the stream reaches for which a reservation is sought.

Response: See response to comment 18.

44. **Comment:** The draft EIS fails to adequately explore how reservations of large blocks of instream flows represent a better method of water allocation than the present system that allows stream leasing and issuance of permits for water rights at the time a demonstrated need for water arises. Failure to show that the reservation process is a superior method of water allocation amounts to a breach of the requirement that the reservation be in the public interest.

Response: Applications for reservations of water in the upper Missouri River basin are authorized by §§ 85-2-316 and 85-2-331, MCA. Other "methods of water allocation" available to reservants are considered by the Board under the criteria of *need*. In order to be granted a reservation, the applicant must establish to the satisfaction of the Board that the reservation is needed (§ 85-2-316(4)(a)(iii), MCA). To do this:

(a) the applicant has demonstrated that there is a reasonable likelihood that future instate or out-of-state competing water uses would consume, degrade, or otherwise affect the water available for the purpose of the reservation; or

(b) where information regarding the effect of future water uses on a proposed reservation is not available, or where the applicant may not be eligible to apply for a water use permit, the applicant has demonstrated that the water resource values warrant reserving water for the requested purpose; or

(c) where the applicant could otherwise seek a water right permit, there are constraints that would restrict the applicant from perfecting a water permit for the intended purpose of the reservation. ARM 36.16.107B(2).

Water reservations are the only method for obtaining instream flow rights. Because there is no withdrawal, impoundment, or diversion of water, applicants are not eligible to apply for a water use permit (see Chapter Two of the draft EIS, pg. 6). The draft EIS assesses the water resource values and also addresses the impacts of granting the proposed reservations on future water availability. Although no water right is obtained, the possibility of leasing instream flows is being studied as described in Chapter Two of the draft EIS, pg. 7. The 1991 Legislature extended the study period to 1999. To date, no leases have been entered into.

45. **Comment:** On page 179, the draft EIS discusses the relationship between BUREC and MPC concerning the annual headwater benefit at Canyon Ferry Reservoir. Headwater benefit calculations indicate a relationship between decreases in power generation

and increased flow depletions. However, the report does not state whether DNRC actually calculated the headwater benefits under additional depletions, or whether other methods were used. This should be stated in the report. Any potential impacts on headwater benefits should be reviewed by MPC and BUREC prior to publication.

Response: DNRC used one approach to calculate all changes in headwater benefits. As described in Chapters Four and Six of the draft EIS, DNRC calculated the changes in headwater benefits caused by consumptive use depletions upstream of Canyon Ferry Reservoir between 1955 and 1986. DNRC also calculated the changes in headwater benefits caused by consumptive use depletions at the 1986 level and at the levels that would occur with the Consumptive Use and Combination alternatives.

46. **Comment:** Under the Montana Constitution, all of the water requested by DFWP, DHES, and BLM already is reserved for future consumptive uses.

Response: The Montana Constitution recognizes and confirms existing rights. It also directed the legislature to provide for the administration, control, and regulation of water rights and to establish a system of centralized records. Mont. Const., Art IX, § 3(1) and (4). To this end, the legislature began the adjudication process to determine existing water rights and established a permitting process for obtaining new water rights. It also instituted the reservation process for public entities to reserve water for existing or future beneficial uses or to maintain a minimum flow, level, or quality of water. The Montana Constitution does not include any provision that reserves water for future consumptive uses.

47. **Comment:** I [Robert Van Deren] feel very strongly that the control of Montana water should remain in the hands of the state and out of federal hands.

Response: The water reservation statute authorizes federal agencies to apply for water reservations (§ 85-2-316(1), MCA).

48. **Comment:** If all of the water reservations are objected to and thrown out, this means no development of any streams. Not a nice thing to think about!

Response: Qualified reservants may apply for water reservations at any time. If a reservation is granted, the priority date is the date of application. However, in order to receive a July 1, 1985, priority date, water reservation applications had to be submitted by July 1, 1989. Individuals and entities also may apply for water use permits for new development.

49a. **Comment:** If, under Board review, a water reservant (i.e., DFWP) meets provisions of the Montana Water Act, how could a need for reallocation be proven in the future?

49b. **Comment:** Page 243 of the draft EIS states:

> The Board may reallocate part or all of an instream flow reservation to another qualified reservant if the Board finds that the water is not required for its original purpose . . . .

Does this mean that future applications for reservations will be permitted when the deadline for applying has passed, or simply that down the road, without public notification and opportunity for objections, the Board can switch water around among existing reservants?

Response: Before the Board can reallocate all or a portion of an instream flow reservation, it must provide notice to the public and an opportunity to object, followed by a hearing. A qualified reservant seeking reallocation must show that all or part of the reservation is not required for its purpose and that the need for the reallocation to the applicant outweighs the need shown by the original reservant. Further, the Board must consider each of the criteria for granting a water reservation established by statute and administrative rules. If the Board orders reallocation, the reservation will retain its original priority date despite reallocation to a different entity for a different use (§ 85-2-316(11), MCA). The procedure for reallocation applies only to instream flow reservations.

50. **Comment:** We [Deadman's Basin Water Users Association] certainly recommend that any water reserved to DFWP and DHES be a shared reservation when a given flow can accomplish the purposes of both agencies. If water quality and fishery concerns can both be served by the same quantity of water, a single or shared reservation should be appropriate. The same principle may apply to other agency requests.

Response: Both DFWP and DHES have applied for water reservations to maintain a minimum flow, level, or quality of water, and their flow requests overlap only on the Missouri River mainstem. If the Board grants both reservation requests, the reservants may be using the same water, but for different purposes and with different priority dates. However, instream flow reservations on the Missouri River, individually or combined, cannot exceed 50 percent of the average annual flow of that stream.

51. **Comment:** DFWP states that its reservation request is in the public interest for the following reasons:

a. The perpetuation of fish and wildlife is in the public interest.
b. The reservation would prevent the gradual depletion of streamflows and the diminishment of recreational use by the public.

There is nothing in the EIS to show how a reservation with a priority date of 1985 will perpetuate fish and wildlife unless the high water is stored for later release when needed to maintain instream flows. No plans were submitted regarding storage to take care of low flows in drought years.

There is nothing in the EIS to show that there will be a gradual, or any, depletion of streamflow without a reservation by DFWP or any diminishment of recreational activities.

Since the passage of the Water Use Act in 1973, there can be no new appropriations without a permit from DNRC. Since that date, DNRC has issued only three permits for irrigation totaling 3.1 cfs and 603 af for 216 acres in the Beaverhead/Red Rock drainage, while issuing two permits for 542 af for fish and wildlife (see Appendix A of the draft EIS).

There is nothing in the EIS to show any diminishment of recreational values over the past years other than problems caused by the drought, or that without a reservation recreational values will decrease in the future.

The EIS fails to support DFWP's claims that there is a need for a reservation. DFWP states that if water is not reserved now and is instead allowed to be appropriated for consumptive use, little water may be available for fish and wildlife in the future. As stated previously, any new appropriations are controlled by the permit system under DNRC, and permits for only 603 af for consumptive use have been issued in the past 18 years on the Beaverhead/Red Rock subbasin.

Response: A water reservation proceeding is an accepted mechanism under Montana water law to protect instream flows for fish, wildlife, and recreation. DFWP states that if water is not reserved now and instead allowed to be appropriated for consumptive use, little water may be available for fish and wildlife in the future. DFWP's reservation request would not enhance the fishery but only help maintain the status quo. The Board will decide whether DFWP has met the need and public interest criteria. Although few new permits have been issued for the Beaverhead/Red Rock drainage basin since 1973, this does not guarantee that changes in existing water rights would not affect the fishery in the future. DFWP's application did not address the issue of storage for enhancing low streamflows. DNRC felt that it was beyond the scope of the draft EIS to speculate on storage sites and the costs of developing them to maintain instream flows.

52. **Comment:** The present leasing program may solve the low flow problems and should be given an opportunity to work.

Response: The water leasing program established by the 1989 Montana Legislature may solve the low flow problems on some streams. However, the legislature has limited the leasing program to 10 streams until the year 1999. Instream flow reservations would not solve existing low flow problems but would help maintain existing streamflows.

53. **Comment:** The state could obtain by purchase or condemnation early water rights that could maintain instream flows if water is not otherwise available.

Response: The state has no express statutory authority to purchase or condemn water rights to maintain instream flows.

54. **Comment:** On page 60 of the draft EIS, DNRC refers to the agreement between MPC and BUREC concerning construction of the Canyon Ferry Dam. As the draft EIS says, MPC originally had a much smaller storage and hydropower project near the Canyon Ferry site. MPC originally had an October 1898 water right at Canyon Ferry for 5,100 cfs for power generation and 23,980 cfs (47,500 af/yr) for storage. MPC transferred the 5,100 cfs water right to BUREC but kept the 23,980 cfs (47,500 af) storage right.

MPC does not have an agreement with BUREC for the release of 5,000 cfs of water through Canyon Ferry. MPC has an agreement with BUREC for the release of water through Canyon Ferry Dam in the amount necessary to prevent injury to MPC's downstream water rights and to maximize conservation and efficient use of water. While the long-term annual flow of the Missouri River and Canyon Ferry may be approximately 5,000 cfs, there is not a minimum flow requirement.

Response: Your comment is noted.

55. **Comment:** On page 26 of the draft EIS (Table 3-2), DNRC refers to MPC's total storage capacity on the Madison and Missouri rivers. This total appears to exclude MPC's storage at Canyon Ferry.

Response: No such statement appears on page 26 or in Table 3-2 of the draft EIS.

56. **Comment:** On page 179 of the draft EIS, DNRC refers to BUREC's water right claims for Canyon Ferry Reservoir and MPC's claims at Hauser and Holter dams. To be accurate, DNRC also may want to mention MPC's storage claim at Canyon Ferry Reservoir.

Response: DNRC acknowledges that MPC has a claimed water right for storage of 47,500 af within Canyon Ferry Reservoir. BUREC's storage rights are much larger and are summarized in Table 4-11 of the draft EIS (p. 59).

57. **Comment:** Is it possible that the existing hydropower facilities already provide an adequate instream flow?

Response: Above Great Falls, instream reservants could be "riding the coattails" of existing hydropower water right holders and sharing the same water unless changes in the purpose and place of these hydropower rights take place.

58. **Comment:** I [Dorothy Stout] feel that water reservations are being deliberately rushed through prior to the adjudication proceedings without sufficient time for senior water right holders to prepare objections in an attempt to adversely affect the position of these senior water right holders.

Response: As explained on page 1 of the draft EIS, the legislature established the time frames and procedures for the upper Missouri River water reservation process.

59. **Comment:** BLM did not object to BUREC's reservation to divert water from the Missouri to the Milk River. BUREC has assured BLM that any water diverted from the Missouri to the Milk River under this reservation would be replaced by a like amount of water from Canyon Ferry or Tiber reservoirs.

Response: According to information in BUREC's application, BUREC plans to make up water that is diverted from the Missouri River into the Virgelle Canal from the Tiber Reservoir when flows fall below the 90th percentile level. During high flows, enough water may be available to satisfy both BLM's federal reserved rights and BUREC's reservation.

60. **Comment:** The purpose of water reservation systems is to evaluate the amount of water available and not allocate more than there is; the public doctrine says that the people own the waters of Montana and, therefore, we [Pat Simmons and Dick Krawiec] have a right to keep minimum instream flows.

Response: The Montana Constitution provides that all waters within the state "are the property of the state for the use of its people and are subject to appropriation for beneficial uses as provided by law." Mont. Const. art. IX, § 3(3). The definition of "beneficial use" under Montana law includes uses accomplished through maintenance of instream flows such as fish, wildlife, and recreation. Through the water reservation system, state and federal agencies and subdivisions of the state may appropriate a minimum flow level or quality of water to accomplish these beneficial uses.

61. **Comment:** There is nothing in the EIS to show how a DFWP reservation of water with a 1985 priority date will contribute to a clean and healthful environment for citizens of the state and the nation.

Response: The protection of instream flows with a 1985 priority date could in some cases help maintain the existing riparian and aquatic environment by preventing new depletions during low flows. Instream flows also could help preserve water quality.

62. **Comment:** On page 61 of the draft EIS, under Murphy rights, there should be some indication of the 1970 and 1971 priority dates of the Murphy rights. None is listed in the paragraph, and there is no reference to priority dates in Table 4-13.

Response: The Murphy rights listed in Table 4-13 of the draft EIS have December 1970 priority dates.

WATER QUANTITY AND DISTRIBUTION

RETURN FLOWS

63. **Comment:** What are the benefits of return flows?

Response: The benefits of return flows depend on local aquifer and hydrologic characteristics, timing and size of diversions, efficiency of canals and irrigation systems, management methods of individual irrigation systems within a drainage, and how close the return flows are to other diversions. An analysis of local hydrologic conditions would be required to determine the extent of the following benefits, which might occur as a result of return flows:

a. Increased instream flows after the peak irrigation season
b. Creation of wetlands
c. Changes in the timing of hydropower production

64. **Comment:** Flood irrigation actually increases water in our creeks by charging springs that feed them. If we didn't irrigate, the streams would dry up early in the summer.

Response: Some of the water diverted for flood irrigation is evaporated or used by plants. The excess water diverted for flood irrigation can seep into the ground or flow on the surface and may later return to the stream. If the amount of water withdrawn from a stream is greater than the amount of water returning (return flows), the result will be a net reduction in streamflows. This usually is the case for an unregulated stream during the peak irrigation season, usually June through mid-September. When irrigation stops in the fall, however, streamflows may increase as some of the water earlier diverted for irrigation returns to the stream.

65. **Comment:** Irrigation return flows provide flows throughout the year in the Red Rock River.

Response: Much of the water diverted for irrigation in the Red Rock drainage eventually will return to streams. During the peak irrigation season, streamflow withdrawals usually exceed returning flows. The result is a net reduction of flow in streams such as the Red Rock River. After the irrigation season, during the fall and winter, return flows from irrigation will increase streamflows.

66. **Comment:** During the spring season, Montana's irrigators are spreading water over the land. Much of this irrigation water runs into the thawed, warm earth. The water that runs into the ground from irrigation goes into a type of unseen storage. Reservoirs and ground storage are two storage possibilities available to people in Montana during warm weather.

Response: Generally, full-service irrigation in the Missouri basin begins in May, with some farmers and ranchers diverting water into canals and onto fields as early as late April. Some systems operate as soon as runoff is available—as early as March in the lower Missouri basin. Much of the water diverted for irrigation will enter the groundwater, where it may remain for a period of months ("ground storage") before returning to a stream.

67. **Comment:** If Montana had more reservoirs and more irrigated land, more water would be stored for the dry summer seasons and drought years, and the streamflows would be more even throughout the seasons and years. If these storage techniques are not used, streamflows are very high during the spring and very low (many large streams entirely dry) during the summer and fall.

Response: Reservoirs could be used to store more water in the spring for release during the summer and fall. A site-specific analysis would have to be conducted to examine the feasibility of each possible storage project. See response to comment 64 for a discussion of the effects of irrigation on streamflows.

68. **Comment:** To keep the water in our streams would cause a major change in our state and a doubtful one. It also appears impossible, as without irrigation the number of dry streams in August and September would increase appreciably and the fishery would suffer.

Response: This comment incorrectly implies that the instream flow reservations would cause all water that is legally appropriated for consumptive uses to be returned to the stream and that irrigation maintains August and September streamflows. Existing water rights with priority dates earlier than July 1, 1985, would not be affected by the reservations. See response to comment 64 for a discussion of the effects of irrigation return flows.

The reservations for both consumptive and instream uses would be senior to water use permits issued since July 1, 1985, and during periods of low flows, enforcement could cause water included in post-1985 permits to be left in the stream. The Board, however, could subordinate the reservations to permits issued since 1985 if it finds that the permits would not interfere substantially with the purpose of the reservations.

69. **Comment:** Each year, 200 significant streams are completely dried by irrigators in Montana—2,500 miles of streams are severely dewatered annually. Irrigation uses 97.6 percent of diverted water from streams. Less than 5 percent of Montanans hold water rights for irrigation but control 97.6 percent of the diverted water. Montana's irrigators are wasteful. Of the 97.6 percent of the diverted irrigation water, only 20 percent is used by the plants—80 percent is wasted.

Response: Stream reaches in the Missouri basin where low flow problems have been identified by DNRC are listed in Tables 4-2, 4-4, 4-6, and 4-8 of the draft EIS. Approximately 95 percent of the water diverted from streams and consumptively used in the Missouri basin of Montana is for irrigation.

Montana has approximately 140,000 water right holders. Approximately 35,000 hold water rights for irrigation, or about 4 percent of all Montanans.

The percentage of water diverted for irrigation that is consumptively used varies by irrigation system. For the EIS, DNRC assumed the following efficiencies for existing irrigation in the Missouri basin of Montana (see Table 3-2).

Of the water that was diverted but not consumptively used, DNRC assumed that 15 percent is lost to evaporation, deep aquifers, or use by plants other than crops. The rest eventually will return to the stream as surface water or groundwater return flows.

Table 3-2. Irrigation efficiencies used by DNRC

Irrigation system type	Percentage of water diverted that is used by crops
Water spreading	15
Furrow/border flood	18
Center pivot sprinkler	49
Other sprinkler	34

70. **Comment:** The draft EIS mentions groundwater recharge but does not examine the effects and benefits of recharge in any detail. It can only be assumed that the preparers of the draft EIS have not examined what would happen to a river such as the Big Hole without recharge. This issue deserves much more investigation. A complete EIS is not possible without a thorough investigation of all factors that influence water flows.

Response: Much of the water diverted for irrigation that is not used by crops eventually will return to the stream. The amount of water available for groundwater return flows (recharge) depends on the type of irrigation system. Table 3-3 compares acre-feet of water diverted from the stream to that returned to the stream as surface water and groundwater return flows. The figures represent each acre-foot consumptively used by an alfalfa crop by irrigation system type. These efficiencies were used in DNRC's Missouri River basin water availability model.

Table 3-3. Amount of water that must be diverted from a stream compared to that which is returned to stream by surface water and groundwater return flows (for each acre-foot used by an alfalfa crop)

Irrigation system type	Amount diverted (af)	Used by alfalfa crop	Surface return flows (af)	Groundwater return flows (af)	Water lost[a]
Furrow/border flood	5.6	1.0	2.0	2.0	0.6
Water spreading	6.7	1.0	2.4	2.4	0.9
Center pivot sprinkler	2.0	1.0	0.1	0.9	0.1
Other sprinkler	2.9	1.0	0.2	1.4	0.3

[a] Calculations assume that 15 percent of the water not consumptively used is lost to deep aquifers, evaporation, or is used by vegetation other than crops.

Surface water return flows come back to a stream shortly after the water is applied to a field. Groundwater return flows will return to streams over a period of months. Using methods described by Glover (1974), DNRC estimated groundwater return flows in the Big Hole River valley (see Table 3-4).

If water were put onto a field August 1, 24 percent of the groundwater return flows would return in August, 20 percent would return in September, 13 percent would return in October, 10 percent would return in November, and the remaining 33 percent would return gradually over the next 8 months.

During July and August, the peak of the irrigation season, irrigation withdrawals generally exceed the amount of water that returns to the stream. Once irrigation stops or substantially decreases during the early fall, the amount of water returning to the stream will exceed the amount diverted. Depending on local conditions, this situation can persist throughout the fall and winter, enhancing flows at

Table 3-4. Groundwater return flow patterns used by DNRC for the Big Hole River valley

Month following irrigation	Percentage returning
1	24
2	20
3	13
4	10
5	8
6	6
7	5
8	4
9	3
10	3
11	2
12	2

this critical time of year when streamflows are near their lowest. Flows in the Big Hole River probably would be substantially lower during the fall and winter without irrigation return flows.

The Wyoming Water Research Center (Wetstein et al. 1989) conducted a study of irrigation return flows in that state's New River Valley. Most of the ranches in this valley use flood irrigation systems, a situation similar to that in the Big Hole valley. The study concluded that an average of 70 percent of the water diverted for irrigation returns to the stream as surface water and groundwater return flows. During average precipitation years, this percentage is 75 percent as opposed to about 50 percent during dry years. Ten percent of the return flow volume was determined to reenter the stream during the low flow winter months.

71. **Comment:** Were it not for the upstream irrigation in May, June, and July on the Big Hole, Ruby, and Beaverhead rivers, the streams would be dewatered by late summer in dry years and the flow substantially diminished in normal years.

Response: See responses to comments 64 and 70.

LOW FLOWS

72. **Comment:** Why is it that in the draft EIS only irrigation is said to cause low flow conditions? What about drought?

Response: Tables 4-2, 4-4, 4-6, and 4-8 in the draft EIS (pp. 46-54) list low flow problem areas and causes of these low flows. Although irrigation is listed as a cause of low flows on many streams, natural causes also are listed. Natural causes include drought and stream-channel seepage.

73. **Comment:** Drought is not the major cause of low flow conditions; it is water use by irrigators.

Response: The cause of low flows varies from stream to stream. In many instances, withdrawals for irrigation can cause low flows during the summer months. In other instances, natural causes such as drought or seepage of water through the streambed may cause streams to become low. A combination of natural and human factors also may cause low flows.

74. **Comment:** Very close to where we [Pat Simmons and Dick Krawiec] live, the Gallatin River south of Axtell Bridge has an entire channel dried up that we have never seen during the 9 years we have owned our land.

Response: Projects GA-35 and GA-40 are located near the Gallatin River south of the Axtell Bridge and would reduce flows in that stream.

75. **Comment:** Cottonwood Creek is dewatered every year. We [Pat Simmons and Dick Krawiec] just yesterday observed the dry channel by I-90 and the extremely low levels at Logan, where we have previously canoed and rafted.

Response: No reservations are requested for Cottonwood Creek.

76. **Comment:** Table 4-2 in the draft EIS (pp. 46-47) indicates that low flows in Poindexter Slough are caused by irrigation; this statement is wrong.

Response: Water is provided to Poindexter Slough by springs, seepage from an irrigation canal, and a canal that diverts flows from the Beaverhead River. Farther downstream, water is taken from the slough for irrigation. In the late summer during drought, flows can become low in portions of the slough because less water is available for diversion into the slough from the Beaverhead River; inflows from springs and canal seepage are reduced, and water continues to be removed from the slough for irrigation.

77. **Comment:** The draft EIS mentions irrigation as the main cause of stream dewatering when, in fact, Montana has been experiencing five to six years of drought.

Response: The drought of the late 1980s through the present has contributed to low flow problems on many streams in the Missouri basin.

78. **Comment:** Pages 46-47 of the draft EIS list the cause of low flows on Big Sheep, Cabin, and Nicholia creeks as irrigation. This is a completely false statement, and I [Bernard J. Harkness] am enclosing the Findings of Fact and Conclusion of Law in Case No. 3808 in the District Court of the Fifth Judicial District. According to pages 8, 9, 10, and 11 of the Findings of Fact, irrigation in Big Sheep basin and the canyon has no effect on the flow in Sheep Creek and its tributaries and does not diminish the supply of water.

I am sending you the Findings of Fact and Conclusion of Law only, but the complete trial transcript is available at the county courthouse in Dillon. The testimony of the witness and the county surveyor unequivocally shows that the type of irrigation practiced in the upper basin has increased the flow of all the streams mentioned. Paragraph V on page 9 states that since irrigation in the upper basin became general, a constant flow has been maintained in Big Sheep Creek, thereby supplying and furnishing water to the lower users, which—except for the use of the upper users—would be lost during the early season runoff.

The same type of irrigation is being practiced today, and any increase in the type of irrigation should increase and stabilize the flow of the above-mentioned creeks.

Paragraph IX, page 10, lists the creeks that do not empty into Sheep Creek except in the spring runoff. Cabin Creek and Simpson Creek are among those listed. Indian Creek is not listed, but the same condition exists there. Indian Creek is in the Cabin Creek drainage.

There is no water left in these streams for any additional appropriation, and the reservation requests on these streams are well above the flow of the streams.

Under the No Action Alternative in this area (Big Sheep Creek and tributaries), there would be little change in any of the general conditions. Irrigated agriculture would remain the same as long as the method of irrigation is unchanged.

Response: The case cited came to trial in 1938 and involved a dispute between water users in the upper and lower portions of the Big Sheep Creek drainage (in the Red Rock River drainage above Clark Canyon Reservoir). The upper portion of the drainage, or "upper basin," encompasses Cabin, Nicholia, and Meadow creeks and their tributaries (see Map 3-1). Much of the land in the upper basin has been developed for irrigation. Big Sheep Creek is formed by the junction of Cabin and Nicholia creeks. From there, it flows through a canyon section before entering the Red Rock River valley. This lower portion of the stream in the valley is referred to as the "lower basin." Canals divert water from Big Sheep Creek near the point where it leaves the canyon to irrigate land in the lower basin.

The outcome of the case was that irrigation in the upper basin and canyon section was not detrimental to flows in Big Sheep Creek and its tributaries and, hence, the water supply for irrigators in the lower basin. The findings of facts and conclusions of law from the case further stated that irrigation in the upper basin has the effect of stabilizing flows in Big Sheep Creek and its tributaries so that larger quantities of water are later found in the stream and for longer periods of time than would occur without such irrigation. These conclusions were based on the testimony of the defendants and their witnesses. However, few data on measured streamflows were available at the time of the trial.

A stream gauging station was operated by USGS on Big Sheep Creek from 1936 to 1979, although the records are not continuous for this period. This stream gauging station was located in the canyon section of the creek below the confluence of Muddy Creek (see Map 3-1). Based on records from this stream gauge, USGS estimates the average annual flow of Big Sheep Creek to be 65 cfs (USGS 1979). Average monthly flows were found to be highest in June during spring runoff (94 cfs) and lowest during the winter in February (41 cfs) (USGS 1989). For comparison, DFWP has requested instream flows of 48 cfs but is limited by statute to half the average annual flow, or 32.5 cfs. BLM has requested a minimum instream flow of 40 cfs and a peak discharge every other year of 300 cfs but also is limited by statute to half the average annual flow.

The University of Montana monitored Big Sheep Creek streamflows at the upper and lower portions of its canyon (University of Montana 1978) (see Map 3-1). Comparing this data indicates that streamflows throughout the year are substantially greater at the lower portion of the canyon than the upper (see Table 3-5). The likely sources of this additional water are springs, runoff, and groundwater inflows originating from the mountains surrounding the canyon. There is a limited amount of irrigated land in the canyon, and its effects on streamflows here probably are small.

Map 3-1. Streams in the Big Sheep Creek drainage

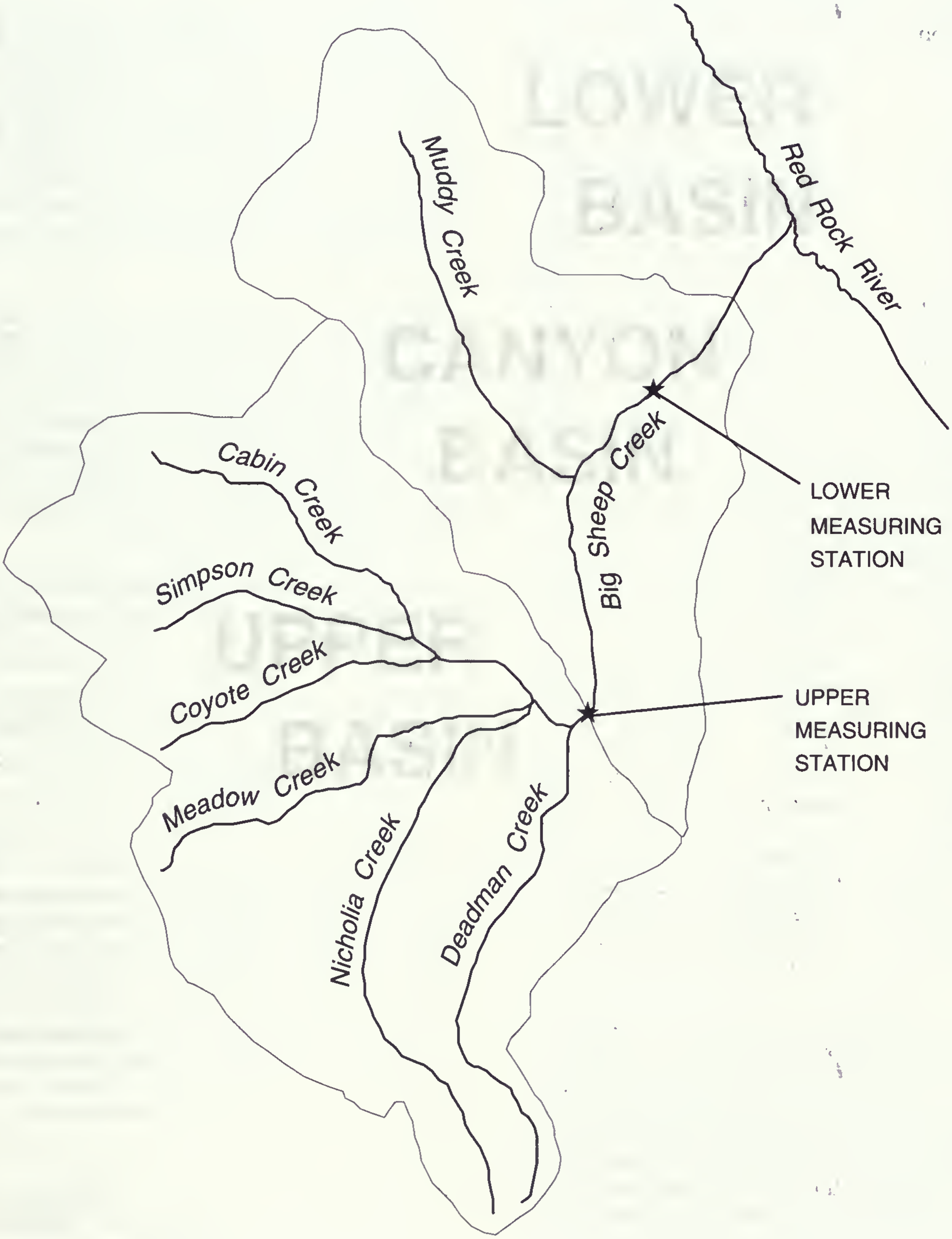

LOWER BASIN
Red Rock River
Muddy Creek
CANYON BASIN
LOWER MEASURING STATION
Cabin Creek
Big Sheep Creek
Simpson Creek
UPPER BASIN
Coyote Creek
UPPER MEASURING STATION
Meadow Creek
Nicholia Creek
Deadman Creek

Table 3-5. Comparison of streamflows at upper and lower portions of BigSheep Creek Canyon as measured by the University of Montana

Date of measurement	Streamflow at upper Big Sheep Creek station (cfs)	Streamflow at lower Big Sheep Creek station (cfs)	Percent increase from upper to lower station
10/27/76	46	78	70
4/21/77	25	62	148
5/1/77	97	51	-47
5/11/77	14	52	271
5/19/77	56	91	62
5/27/77	50	80	60
6/10/77	122	234	92
6/25/77	38	75	97
7/12/77	15	44	193
7/26/77	70	102	46
8/29/77	24	59	145
9/23/77	7	51	629
9/29/77	13	48	276
10/15/77	21	52	148
3/30/78	67	130	94
4/4/78	24	57	138
4/12/78	24	58	142
4/19/78	17	53	211
4/26/78	31	60	94
5/4/78	21	62	195
5/10/78	38	78	105
5/16/78	32	74	131
5/22/78	54	100	85
5/31/78	44	79	80
6/8/78	80	112	40
6/14/78	117	149	27
6/19/78	87	132	52
6/27/78	94	118	26
7/19/78	47	84	79
8/14/78	32	70	119

Source: University of Montana 1978.

Irrigation withdrawals can cause low flows from the point where Big Sheep Creek leaves the canyon to its confluence with the Red Rock River. Most of the return flows from this irrigation enter the Red Rock River. Table 4-2 in the draft EIS has been changed. References to Big Sheep Creek under the Beaverhead River have been deleted. Where Big Sheep Creek is referred to under the Red Rock River drainage, the stream reaches where low flow occurs have been changed from "portions of creek" to "below canyon to mouth." (See "Changes to the Draft EIS.")

Instream flows also have been requested by DFWP and BLM for Cabin Creek, Indian Creek, and Simpson Creek, all in the Big Sheep Creek drainage. Low flow problems occur on the lower portions of these streams, but these may be the result of natural factors.

79. **Comment:** The draft EIS (Table 4-2, p. 46) says that low flows on the Beaverhead River from the East Bench diversion to the mouth are caused by the reservoir and irrigation. What the EIS does not show are the inflows and releases from storage of Clark Canyon. These will show that without releases from storage, the streamflow would have been greatly reduced or nonexistent during the summer months after runoff. The reservoir helps in maintaining the flow rather than causing the low flow.

Response: DNRC does not believe that Clark Canyon Reservoir operations cause low flow problems in the Beaverhead River above the East Bench diversion dam. Reservoir operations have been removed from Table 4-2 as being a cause of low flows in this stream reach (see "Changes to the Draft EIS"). Diversions at the East Bench Diversion Dam 16 miles below the dam do substantially lower flows in the Beaverhead River below that point.

80. **Comment:** USGS should establish the baseline condition without irrigation. The results would show that there still will be low flows without irrigation.

Response: USGS presently is working on a project to establish such "baseline conditions." Conclusive results from this analysis will not be available in time for publication in this EIS.

81. **Comment:** The rivers and streams in the upper Missouri River basin are severely and chronically dewatered, even in average water years such as this one. DNRC already has issued water use permits that our aquatic ecosystems cannot accommodate. The message is clear from the tables and text in the EIS that show the impacts of proposed additional diversions—the Jefferson River projected to have zero flow, the lower Madison subject to additional extreme stress from warm temperatures and arsenic, the Big Hole with continued deterioration of fisheries, etc.

Response: Streams on which DNRC believes low flow problems occur are presented in Tables 4-2, 4-4, 4-6, and 4-8 of the draft EIS (pp. 46-54).

82. **Comment:** On page 46, Table 4-2, some stream reaches where low flows occur are identified only as "portions of creek." This is an inadequate description of the location or extent of the dewatering problems on those streams. Even on those stream sections where a reach is identified more specifically, the extent of the dewatering is not shown. What a low flow represents may be a state of mind with different individuals, and it may be difficult to convince the Board that new water uses should not be issued on these streams without some better definition of how low the streamflow actually gets. There should be some language in the draft EIS that states that no new diversionary water uses should be allowed on these stream sections, including reservations of water, until a more specific water availability analysis is made.

Response: Tables 4-2 and 4-4 of the draft EIS present a partial list of streams that exhibit low flow conditions to portray an overall picture of the condition in the subbasins. Sufficient data are not available to determine how low a particular stream is at a given place and time and what degree of dewatering is critical to all streams considering available water quality parameters and conditions. Streams exhibiting critical low flows and other water quality impairments as determined from available data are listed in Appendix E of the draft EIS.

83. **Comment:** On page 46, under "East Gallatin River," we [DFWP] are not certain that Thompson Spring Creek has a dewatering problem.

Response: Information from DFWP (1990) indicates that the stream bottom in Thompson Spring Creek is periodically exposed due to bank erosion and channel filling.

84. **Comment:** On pages 46 through 54, Tables 4-2, 4-4, 4-6, and 4-8, the dewatering discussion should include a caveat that these are *some* of the low flow problem areas and may not be an all-inclusive list.

Response: DNRC recognizes in the draft EIS (p. 45) that these tables are not all-inclusive.

WATER AVAILABILITY

85. **Comment:** How can these agencies reserve more water for instream flow than actually exists in the state of Montana?

Response: The reservants could not reserve more water than exists in the state or the Missouri River basin. Instream reservants are limited by statute to half the average annual flow on gauged streams. This is equivalent to 3.5 million af/yr on the Missouri River near Landusky. The average flow for the Missouri River near Landusky is more than 7 million af/yr. Reservation applications for consumptive use total 511,796 af/yr. If all consumptive use requests were granted, August flows in the Missouri River at Landusky would be reduced 24 percent in the driest 1 year in 10.

86. **Comment:** DFWP is asking for more water in the Musselshell River than there usually is. There are 80 cfs in the spring, but people are starting to irrigate with this water.

Response: DFWP has requested 80 cfs year-round in the reach of the main-stem Musselshell from the confluence of the headwaters to the Musselshell diversion dam above Melstone, and 70 cfs year-round from the reach between the Musselshell diversion dam and the mouth. Flows are frequently below the DFWP reservation requests during the summer, fall, and winter of average and dry years. Figures 3-1 and 3-2 (see response to comment 4) show monthly percentile exceedance flows for the Musselshell River at Harlowton and Mosby. These figures illustrate that flows usually are greater than the reservation requests during the spring months, but below them during the summer, fall, and winter of dry years.

87. **Comment:** DFWP is requesting more water for instream flows than is available in Swimming Woman and Careless creeks.

Response: For all months except May, June, and July, streamflows usually are lower than those requested by DFWP on Swimming Woman Creek and on Careless Creek. DFWP is requesting 2.5 cfs year-round for instream flows in Swimming Woman Creek, and 2 cfs year-round in Careless Creek. Appendix D, pages D-19 and D-20 of the draft EIS, shows monthly flows for these streams.

88. **Comment:** BLM did not object to municipal water reservations due to the higher priority granted to municipal use in comparison to instream flows. BLM feels, however, that the cumulative reservations for municipal use could reduce necessary instream flows in the wild and scenic portion of the river and, therefore, impact the United States's senior federal reserved water right on the Upper Missouri Wild and Scenic River. We [BLM] therefore

request that you consider the potential cumulative impact of these municipal uses on existing downstream water rights.

Response: Impacts to streamflows on the wild and scenic portion of the Missouri River attributable to municipal requests would be small. As shown in Appendix A, streamflows in the Missouri River at Fort Benton, Virgelle, and Landusky (near the wild and scenic portion of the Missouri) would be reduced less than one-tenth of a percent in all months during wet, average, and dry years if only municipal requests were granted.

89. **Comment:** Page 11 of the draft EIS states: "By law, the instream reservations together cannot exceed 50 percent of the average annual flow of record on gauged streams." As an example: On the Musselshell River near Roundup, Table D-1 in Appendix D shows an annual average flow of 210 cfs. DFWP has requested an instream reservation at that point of 80 cfs. This appears to comply with the law. However, average flows are a statistical aberration that masks what may be normal. Four out of five years, historical flow rates only are sufficient to provide for this reservation at lawful percentages, one month each year (June). This month has flow supplemented by offstream storage release. Normally, expected flows not only are too small to lawfully provide for such a large reservation, but they don't even flow at rates sufficient to provide 100 percent of the reservation request. This statistical occurrence needs to be further analyzed since it does not meet the intent of the law.

Response: The reservation statute (§ 85-2-316, MCA) states that the Board shall limit any reservations it awards to a maximum of 50 percent of the average annual flow of record on gauged streams. No other statistical limitations are required or suggested by the statute.

90. **Comment:** DFWP's application fails to show a need for instream flow reservations on the Beaverhead River and its tributaries. The streamflows in the summer and fall are presently maintained by storage release and by return flows resulting from upstream irrigation. Any diminishment of upstream irrigation would adversely affect the ability to maintain downstream minimum flows.

Response: The Board will determine whether DFWP has shown sufficient need for its reservation requests. See response to comment 64 for a discussion of the effects of irrigation return flows on streamflow. If granted, reservations would be junior to pre-July 1, 1985, water rights and, therefore, would diminish little if any upstream irrigation. Only one water use permit application has been submitted to DNRC for new water use in the Beaverhead River drainage since July 1, 1985; under this permit, 50 acres would be irrigated.

91. **Comment:** Did DNRC evaluate each proposed reservation in the field and talk to local people about water availability for all proposed reservations?

Response: DNRC did not evaluate each proposed reservation in the field and did not talk to local people regarding water availability for each reservation request. Forty public entities applied to reserve water, and their applications include 559 individual reservation requests. DNRC did not feel it was possible—given available time and resources—to evaluate each of these in the field for the draft EIS. DNRC did conduct field evaluations of nearly all of the projects proposed by 15 conservation districts below Canyon Ferry Dam and spoke with landowners regarding water availability for them. DNRC also used information on local conditions determined by its employees working in regional offices throughout the Missouri basin.

92. **Comment:** The draft EIS does not adequately address the impact one reservation has upon another. An upstream water reservation removes that water from consideration for downstream use. A downstream reservation also limits the amount taken by upstream reservations. The draft EIS makes no analysis of the effects of one specific reservation upon all others.

Response: The impacts that one water reservation request may have on another are addressed in the draft EIS. The Missouri River water availability model was used to simulate the effects that granting reservation requests would have on streamflows and the availability of water for other reservation requests—both upstream and downstream. In addition, draft environmental assessments are available for each reservation application and show the effects that individual consumptive use projects would have on streamflows.

93. **Comment:** The draft EIS inadequately addresses BUREC's diversion of Missouri River water to the Milk River. There is no discussion as to the

effect this diversion might have on upstream water requirements.

Response: If granted a reservation, the Virgelle diversion project would have a priority date of July 1, 1985. The project would divert a maximum of 280 cfs, leaving less water available to any upstream appropriators with a later priority date. Upstream or downstream water users with an earlier priority date would not be affected by the project. BUREC would prepare a separate EIS before constructing this project.

94. **Comment:** The reservation flows requested by DFWP passing Clark Canyon Dam on the Beaverhead River exceed the 50 percent limitation of annual river flows as established by the legislature. The reserved flows exceed the total flows of the Beaverhead River for 1988, 1989, and 1990.

Response: DFWP has requested a water reservation of 200 cfs and 144,793 af/yr in the Beaverhead River from Clark Canyon Dam to the mouth. The Beaverhead River is measured at Barretts and Twin Bridges. Average annual flows to the year 1990 are 319,500 af/yr at Barretts and 303,600 af/yr at Twin Bridges. DFWP's reservation requests do not exceed half the average annual flow of the stream.

Continuous streamflow gauge records are available for the years 1988, 1989, and 1990 for the Beaverhead River at Twin Bridges. Here, average annual flows were less than DFWP's reservation request on an annual basis in 1990 when they were 132,600 af, and in 1989 when they were 136,000 af. Flows in 1988 were 164,500 cfs, greater on an annual basis than those requested by DFWP.

95. **Comment:** DFWP and DHES do not recognize the large differences in natural flows from year to year in the headwater streams and rivers and, therefore, do not explain the source of water for their reservations during extended drought periods.

Response: Appendix D of the draft EIS presents streamflows for wet, average, and dry years where reservations are requested. In dry years, streamflows may not be available to satisfy reservation requests on some streams.

GROUNDWATER

96. **Comment:** On page 157 of the draft EIS, DNRC describes its assumption that when water is pumped from proposed groundwater wells in the Gallatin River drainage, the same amount of water is removed from associated streamflows. Please explain the basis of this assumption. Is the same assumption applied to all other areas for which groundwater wells have been proposed? For example, on pages 158 and 159, DNRC refers to the impact from proposed groundwater wells near the Boulder and Beaverhead rivers. Are the conclusions presented by DNRC based on the same assumption as those for the Gallatin valley? If not, please state DNRC's assumptions concerning groundwater withdrawal in each subbasin and explain why the assumptions are different.

Response: In the draft EIS, DNRC assumed that groundwater withdrawals would result in direct and immediate depletions to surface water flows; this assumption is made for all groundwater withdrawals. DNRC made this assumption because of the complexity of predicting depletions to surface water sources from groundwater pumping. Because of the use of this assumption, impacts to streamflows associated with groundwater withdrawals stated in the draft EIS are worst-case scenarios. In reality, impacts usually would be less. Impacts to streamflows from groundwater pumping would depend on the well's distance from a stream and the aquifer's hydrogeologic characteristics.

97. **Comment:** You should drill wells to satisfy municipal reservations rather than take surface water from agriculture.

Response: Any reservations granted would be junior to and not affect agricultural water uses established prior to July 1, 1985. Many of the municipalities have applied for groundwater as their reservation source (see Table 3-4 of the draft EIS, p. 35). In many cases, groundwater withdrawals would reduce streamflows.

FLOW ESTIMATES

98. **Comment:** On page 13 of the draft EIS, you say some streamflows were estimated. This is an incompetent way of measuring water.

Response: Historical streamflow records were unavailable for many streams for which reservations are requested. In these instances, DNRC and the applicants found it necessary to provide streamflow estimates. See response to comment 339 for a discussion of the flow estimation techniques used.

99. **Comment:** There are many inaccuracies in the draft EIS tables as I [Randall P. Smith] read them. I would like to point out the following:

> Appendix I, Table I-1, Big Hole River Drainage, Divide Creek

These average monthly flows are absurd; the only reason for these flows is the addition of ditch water from an irrigation ditch that comes out of the Big Hole River. This river water is co-mingled with Divide Creek water above the point of flow measurement.

Response: The monthly average and percentile streamflows for Divide Creek presented in Appendix D of the draft EIS were estimated by USGS (1989) because long-term flow records were not available for this stream. Streamflows for Divide Creek were estimated using flow records for other gauged streams in the basin, measured characteristics of the Divide Creek basin, and channel width and streamflow measurements. The estimates are for Divide Creek streamflows that originate from its basin above Divide. They do not include canal flows from the Big Hole River that are diverted into the lowermost portion of the stream.

100. **Comment:** I [Garrison Ranches, Inc.] feel that the estimated flow rates used and charted in the draft EIS are not presented in a very understandable manner, and they do not verify very many of the reservations requested. Nor is the source of these figures clearly stated.

Response: An explanation of the way flow rates are presented in the draft EIS is found on page 43 (also see responses to comments 109 and 339). The draft EIS was prepared to analyze impacts that could result from the Board's action on the reservation applications—not to verify reservation requests. The source of these figures (USGS 1989) is stated in the draft EIS.

101. **Comment:** On page 48 of the draft EIS, Table 4-3, the monthly inflows to Canyon Ferry Reservoir are inconsistent with BUREC's Hydromet records. The outflows from the reservoir also are inconsistent with our [BUREC] records. Please address these inconsistencies and provide the period of record that was used.

Response: The average and percentile streamflows presented in Table 4-3 were calculated for the period of 1937 to 1986. Because Canyon Ferry Reservoir was not completed until 1953, estimates of monthly streamflows before that year were used. BUREC's Hydromet records are based only on the time that the reservoir has been in operation. Therefore, calculating average and percentile flows using these records would yield different results than those presented in Table 4-3.

102. **Comment:** The period used in the EIS to determine average river flows does not include the most serious extended period of drought recorded on the Beaverhead River—the period from 1986 through 1991. By not including this period in the EIS, the EIS average is considerably above the true average.

Response: DNRC used the period of record for each gauging station until 1990 to determine whether reservation requests exceed half the average annual flow. For the Beaverhead River at Twin Bridges, the average annual flow calculated for the period of record from 1935 to 1990 is 303,600 af/yr. The average annual flow calculated for the period of record from 1935 to 1985, before the drought, is 315,200 cfs, or only 4 percent greater.

103. **Comment:** In computing average streamflows, it appears that the drought years of the early 1930s and the past four drought years were eliminated; however, the 1984 year of a 100- to 500-year flood runoff was included. This clearly distorts the real average and unrealistically raises the limitation of 50 percent of the average annual flow as required by § 85-5-331, MCA.

Response: In determining whether reservation requests on gauged streams exceeded average annual flows, streamflows for the period of record through 1990 were used. For gauging stations with relatively long periods of record, flood flows—although dramatic—generally will have small effects on long-term average streamflows. In this example, flood flows during 1984 were thought by the commenter to have distorted flow records. The commenter represents water users in the Big Hole, Red Rock, and Ruby drainages.

Table 3-6 compares average annual flows as computed for the period of record ending in 1983—prior to the high flows—to those as computed for the period of record ending in 1984—after the high flows—for selected stream gauging stations. As the table illustrates, changes between the years are small.

Table 3-6. Average flows computed for periods of record ending 1983 and 1984, and percentage change between years

Station	1983 (cfs)	1984 (cfs)	% Change
Beaverhead River at Barretts	311,500	318,100	2.1
Big Hole River at Melrose	849,800	852,700	0.3
Ruby River above reservoir	131,100	133,300	1.7

Note: Periods of record are 1907 to present for Beaverhead River at Barretts, 1923 to present for Big Hole River at Melrose, and 1938 to present for Ruby River above the reservoir.

104. **Comment:** In Appendix I-5, Mill Creek is measured at the forest boundary, which is above all senior water rights. The stream is overadjudicated, and there obviously is no water for reservations.

Response: DFWP has requested a reservation on Mill Creek from the outlet of Branham Lake to the mouth. Approximately a third of the stream reach for which a reservation is requested is above the Beaverhead National Forest boundary. Flow estimates for Mill Creek at the National Forest boundary are presented in Appendix D of the draft EIS. Below the forest boundary, streamflows are likely to be less at times due to irrigation withdrawals and stream channel seepage. Your comments regarding the legal availability of water in this stream for appropriation are noted.

MISSOURI RIVER WATER AVAILABILITY MODEL

105. **Comment:** What does the computer model show?

Response: The Missouri River water availability model was used to analyze physical and legal water availability in the Missouri basin and to assess impacts that the proposed reservation requests could have on streamflows, reservoir levels, and hydropower production. A more detailed description of the model is presented in Appendix C of the draft EIS.

106. **Comment:** The DNRC computer model is not explained. What exactly does it show? How were the inputs determined?

Response: An explanation of DNRC's Missouri basin hydrology model is presented in Appendix C of the draft EIS. The model estimates streamflows at 35 locations throughout the basin, assuming a 1986 level of irrigation development and the effects that each alternative would have on streamflows. Page C-3 of the draft EIS provides an explanation of inputs and their sources.

107. **Comment:** Since this study (the EIS) is dependent on the results of the hydrology model, more information should be provided in Appendix C concerning study methodologies, assumptions, special criteria, input parameters, consumptive use of new irrigation, reservoir operations, allocation of future demands against existing rights, and other pertinent information necessary to determine whether the modeling and results were handled correctly. A detailed, step-by-step description of all procedures should be provided, along with assumptions and data used in the development of the hydrology model. We [BUREC] will provide additional comments after receiving this information. At this time, we cannot fully evaluate the adequacy of the hydrology model. We are not sure of the accuracy of the results and, hence, of the draft EIS as a whole.

Response: The commenter [BUREC] was involved in the model development from the beginning and, as such, has the technical information requested and has had sufficient time in which to evaluate it. Providing a detailed, step-by-step procedure of the model along with all assumptions, special criteria, future demands, reservoir operations, data used, etc., would be too lengthy and technical for the EIS. The model and all information concerning it are available from DNRC. DNRC appreciates comments on the model, even if received too late to be incorporated in the EIS process.

108. **Comment:** In several cases, the draft EIS discussed the operation of Fort Peck Reservoir. However, the report does not mention whether the reservoir was operated independently or as a portion of the entire mainstem system coordinated by the Corps of Engineers. The Corps operates all six reservoirs on the Missouri River as a single unit. The EIS should state how Fort Peck was operated and whether the Corps agreed to the operation.

Response: Fort Peck Reservoir operations were modeled using a modified version of BUREC's Canyon Ferry Reservoir operations model. Information on Fort Peck Reservoir operations provided by the Corps of Engineers was used in this modeling. The modeled operations then were adjusted so that predicted reservoir outflows approximated recorded outflows. DNRC did not model operations of downstream reservoirs outside of Montana; this was considered beyond the scope of the EIS. The Corps was not contacted to determine whether it agreed with the operation model used by DNRC.

109. **Comment:** The use of percentile exceedance flows to represent model results is not adequate. Flow values for each month of each year should be presented for all stations. Without these values, it is not possible to verify model results. Since many of the conclusions in the draft EIS are based on the results of this model, the lack of monthly reservoir operation output in the draft EIS makes it difficult to adequately evaluate the results and conclusions.

Response: In the modeling effort, streamflows were simulated for 58 years at 35 locations for four scenarios (baseline conditions and Consumptive Use, Instream, and Combination alternatives). Presenting flow values for each month of each year for all stations would amount to 8,120 lines of information—or more than 100 pages of text. The value of presenting such information in an EIS is questionable.

Using statistical techniques to summarize data and results is appropriate for a document with the scope of the EIS. An accepted method for summarizing hydrologic data is presenting average and percentile exceedance streamflows (see p. 43 of the draft EIS for a description of percentile exceedance flows). Information such as that presented in the draft EIS gives the reader an idea of the status of streamflows during wet, average, and dry years. If only monthly data were included, readers would be left on their own to summarize the information into a useful format.

Raw data to verify model results are available from DNRC.

110. **Comment:** In order to properly address the operation of BUREC reservoirs, it is necessary to review monthly output of the study's scenarios and to know what input assumptions were made. Please provide us [BUREC] with this information. In addition, the selection of reservoirs used in the model is not adequate. Major reservoirs such as Clark Canyon and Gibson, along with several smaller state and private reservoirs for which data are available, were not included in the model. This should be corrected because the presence of reservoirs in a drainage basin has a large impact on the basin's hydrology. If reservoir effects are ignored in a hydrologic analysis, results are not valid. If the draft EIS conclusions for Tiber Reservoir are based on historical operations, they may not be valid. Before 1982, Tiber was operated at lower levels until dam safety problems were rectified.

Response: This information has been provided to BUREC. Because of technical and time constraints, DNRC modeled reservoir operations on the Madison, Missouri, and Marias rivers only. In other drainages, reservoirs were not modeled, even though they do have a large impact on streamflows in many instances. Because DNRC used streamflow records as input to the model, however, reservoir operations were taken into account indirectly. Tiber Reservoir operations were modeled using operation criteria presently used by BUREC.

111. **Comment:** The model apparently does not consider existing water rights. We [BUREC] cannot determine whether shortages are properly appropriated and accounted for throughout the basin in water-short years.

Response: DNRC feels that the flow reductions from existing water rights are adequately accounted for in the model because these uses are reflected in the historical streamflow records and irrigated acreages used as input data for the model.

112. **Comment:** Appendix C of the draft EIS includes a section titled "Climate Change." Depending on the global climatic model used, effects on the Missouri River basin could be much more than those stated on page C-5, some of which could be beneficial. Also, since global climate change modeling techniques and scenarios are still being developed, the value of including this section is questionable.

Response: Because of uncertainties, the draft EIS does not account for anticipated effects of global climate change. However, it remains important to recognize that future climate and water availability conditions may differ from those upon which the draft EIS is based.

While some areas of North America are likely to experience extended growing seasons and improved moisture conditions, much of the Rocky Mountain region is likely to become warmer and drier. If the

Missouri basin in Montana becomes warmer and drier, the types of conflicts that were experienced during the drought of the 1980s would become more widespread.

113. **Comment:** Were existing municipal and industrial demands included in baseline model runs? If not, these should be accounted for.

Response: Municipal and industrial uses account for less than 3 percent of the water consumptively used in Montana's Missouri River basin (see Figure 4-1 in the draft EIS, p. 42). DNRC did not feel it was necessary to isolate the relatively small amounts of water consumed by these uses. Instead, DNRC felt that any flow reductions from these uses would be reflected adequately in the historical streamflow records used as input data to the model.

114. **Comment:** On page 238 of the draft EIS, Figure 6-23 indicates negative reservoir storage (in Canyon Ferry Reservoir). Also, in Figure 6-24, "Existing Conditions" contents are sometimes less than "Consumptive Use Alternative" contents. Please address these apparent errors.

Response: Canyon Ferry Reservoir was completed in 1953, and hydropower production started in 1955. DNRC modeled streamflows, reservoir operations, and hydropower production for the 1929-to-1986 base period. Figures 6-23 and 6-24 are intended only to show that in the event of another drought cycle such as that of the 1930-40s, it would not be possible, using Canyon Ferry Reservoir, to maintain MPC's headwater benefits at the 1955 or 1986 level of development under the Consumptive Use Alternative. In fact, the reservoir would have been nearly drained.

The reason the reservoir level is lower in some years under existing conditions than it would be under the Consumptive Use Alternative is that late fall and winter return flows from increased irrigation under the Consumptive Use Alternative would prevent the reservoir from dropping as far.

115. **Comment:** The water quantity model used to determine the availability of water on certain streams and the impacts of projects on water availability is limited in that there are not enough nodes on important streams or tributary streams to allow much specificity in quantifying the impacts of projects on the flow regimes. In Chapter Four, the draft EIS does, in a narrative fashion, briefly describe where some low flow problems occur in the basin. The description of dewatering is more specific for some streams than for others. Even though the dewatering cannot be quantified as it is at points where nodes are established, the draft EIS needs to make evident to the Board that such dewatering may be quite significant even on smaller streams. Otherwise, it would be easy to overlook the impacts of new water uses on these stream reaches, which do not have the benefit of more specific quantification of flow conditions.

Response: Technical constraints limited the number of points where DNRC could examine water availability and the effects of water reservations on streamflows using the Missouri River water availability model. For each model node and for each year of the 1929-to-1986 base period, streamflow records had to be obtained or streamflows simulated, information had to be compiled on irrigated acreage by irrigation system type, and information had to be obtained for crop consumptive use requirements. All of this information then had to be entered into the model. Adding more nodes to the model adds complexity that makes running and troubleshooting the model more time-consuming and difficult. DNRC felt that the 35 nodes identified and modeled were adequate for the purpose of the EIS.

Depletions and low flows that would result from reservations for consumptive use on streams and stream reaches not included in the Missouri River water availability model also were estimated by DNRC. The results can be found in Chapter Six of the draft EIS and in the individual environmental assessments. However, DNRC's examination focused only on streams in which diversions by reservations would lower flows. Streams with existing low flow problems were identified in Tables 4-2, 4-4, 4-6, and 4-8 of the draft EIS.

116. **Comment:** On page 154, column one, paragraph two, last sentence, although model results may show that in some cases irrigation return flows lessen impacts of irrigation withdrawals during certain time periods, it should be mentioned that during other time periods during the summer irrigation season, water withdrawals cause low flows that have significant adverse impacts on fisheries in certain stream reaches.

Response: Impacts of irrigation projects on streamflows and fisheries are discussed throughout Chapter Six of the draft EIS.

GENERAL

117. **Comment:** If the instream requests for the Ruby, Beaverhead, Big Hole, and Jefferson rivers were added together, more than 4 million af/yr would go to fish in North Dakota.

Response: The most water that could leave the Jefferson drainage as a result of reservations would be 796,363 af/yr because this is the volume requested at the most downstream reach.

118. **Comment:** It is stated that requests may not be for more than 50 percent of flow, yet reservation requests add up to probably more water than exists in the state of Montana:

Cities and towns	34,659 af/yr
Conservation districts	399,199 af/yr
Bureau of Land Management	143,924 af/yr
DHES	10,863,620 af/yr
DFWP	31,961,260 af/yr
TOTAL	43,402,662 af/yr

Response: Reservation requests for consumptive use can be added. Adding instream reservation requests, however, produces meaningless results. Because instream uses are nonconsumptive, the same water can be reserved at several locations. Instream reservations are only for the stream reach requested—they do not continually add up as one moves downstream.

119. **Comment:** Irrigators should attempt to increase irrigation efficiency before they divert more water for consumptive uses.

Response: Increasing irrigation efficiencies would, in many instances, allow irrigators to maintain crop yields while diverting less water from streams. A typical example of this would be an irrigator switching from a flood irrigation system, where often four times as much water must be diverted as is needed by crops, to a sprinkler system, where only twice as much water must be diverted as is needed by crops. However, excess water returning to the groundwater system or stream (return flows) would be less with the sprinkler irrigation system than with the flood system. In some instances, this could cause reduced fall flows, lower water table levels, and the drying of previously wet surface areas.

120. **Comment:** The EIS did not assess the effects of reservation requests on other reservation requests with regard to water supply.

Response: DNRC did assess the effects of requested reservations on other requested reservations with regard to water supply in the draft EIS. The fact that many reservation requests are competing with each other for a limited amount of water was one of the reasons for developing the alternatives. Where not enough water is available for all requests, some proposed reservations were given priority over others in the alternatives.

121. **Comment:** We question the use of the term "consumptive use" in the draft EIS, since evaporation from reservoirs and streams also depletes water

Response: As used in the draft EIS, "consumptive use" generally refers to diversion and use of water for irrigation or by municipalities. This is opposed to instream flows that require no actual diversion of water. Evaporation of water from stream channels and reservoirs removes water from other uses, and this is a form of consumption. The amount of water lost to evaporation in reservoirs can be large, as illustrated in Figure 4-1 of the draft EIS (p. 42). Streams also lose water through evaporation and use by streamside vegetation.

122. **Comment:** How was consumptive use determined? Is it multiple use? Consumptive use has very little impact on instream flow during periods of high runoff.

Response: Consumptive use for irrigation projects was determined by calculating crop irrigation requirements and dividing this by the efficiency of the proposed irrigation system. Consumptive use for municipal reservation requests was determined by comparing the amount of water diverted by each city to that leaving the wastewater treatment plants and that which leaks from the distribution system. Irrigation and municipal uses are considered single uses in the draft EIS. DNRC agrees that the proposed consumptive uses have little impact on streamflows during periods of high runoff unless the water is stored for later use.

123. **Comment:** On page 249, the draft EIS says that "Milk River irrigators face water shortages in 4 years out of 10." The 1990 Milk River Water Supply Study concluded that shortages exceeded 10 percent of demand in 6 years out of 10.

Response: The statement on page 249 regarding water shortages in the Milk River basin was taken from the pamphlet titled *The Milk River—Making It Meet The Need* (Milk River Irrigation Districts undated). The information included in this brochure represents a cooperative effort among the Milk River irrigation districts, DNRC, the 49th Parallel Institute, and BUREC. Information sources included results from a DNRC/BUREC hydrologic model of the Milk River basin.

124. **Comment:** Evaporation losses shown in Figure 4-1 of the draft EIS (p. 42) seem high. Please provide backup data that support this information.

Response: Two types of information were used to calculate evaporation losses. First, information from the Missouri River Basin Commission (1981) and DNRC's dam safety data base (summarized in Table 4-14 of the draft EIS) was used to determine reservoir surface areas. Expected evaporation rates from the reservoirs were derived from U.S. Weather Bureau evaporation maps (U.S. Department of Commerce 1959). These maps provide a series of local area estimated evaporation rates, averaging about 3-1/3 af of water evaporation per acre of reservoir surface annually.

125. **Comment:** How can the Board know whether water is even available in the Beaverhead subbasin before the groundwater study is completed?

Response: In the Beaverhead subbasin, the only request for consumptive use that may alter streamflows in the Beaverhead River is a well proposed by the City of Dillon that would pump 202 af/yr at a maximum rate of 1.1 cfs from alluvial deposits in the Beaverhead River valley.

The purpose of the groundwater study is to examine the effects that pumping by high-capacity irrigation wells on upland benches near the Beaverhead River may have on flows in that stream. DNRC is participating in this study.

The groundwater study will not be finished until 1995. By statute, the Board must reach a decision on the water reservation applications by July 1, 1992.

126. **Comment:** The draft EIS fails to recognize the potential benefits of expanded water conservation programs. While this issue may be outside of the [Teton County Conservation] District's scope of the reservation process, it will have an effect on water availability for both instream and consumptive uses. The District feels that an effort should be made to assist current water right holders to increase their efficiency. This would provide more water for instream uses or new withdrawals. We feel that it is important to explore how water conservation could be applied to existing rights. The saved water then could be used for future planning and reservations.

Response: In some instances, implementing water conservation measures would increase streamflows and provide water for reservation requests. None of the applicants, however, proposed to use water conservation measures to satisfy their reservation requests. To determine whether water conservation measures would provide benefits to reservants, these measures would need to be examined on a case-by-case basis. This type of examination is beyond the scope of this EIS.

127. **Comment:** On page 61 of the draft EIS, DNRC refers to the 1987 DeLuca study concerning modification of Canyon Ferry Reservoir operations. The DeLuca study is a master's thesis written by Denise DeLuca and is based on a simplified system of Canyon Ferry operation. Before the study can be used as a decision-making document, a more definitive analysis is necessary.

Response: The objective of the DeLuca study was to determine whether BUREC could modify Canyon Ferry operations and allow more consumptive use while at the same time maintaining existing levels of hydroelectric production. As of the draft EIS's publication date, this study was the most extensive modeling effort completed on Canyon Ferry Dam and Reservoir operations. Nowhere is it suggested that this study be used as a decision-making document.

128. **Comment:** I [Mark Clemow] don't feel there is enough time spent in the draft EIS about what effects a drought has on the Missouri River and its subbasins.

Response: One of the bases for analyzing impacts of reservation requests in the draft EIS was the Missouri River water availability model. This model predicts streamflows for wet (20th percentile), average (50th percentile), and dry (80th percentile) years, along with the effects that water reservations would have on these flows. Impacts to the existing environment, including those during dry years, are presented in Chapter Six. Other streamflows and analyses presented in the draft EIS also are for wet, average, and dry years.

129. **Comment:** On page I-3, Table I-1, on four streams in the Gallatin River drainage, DFWP requested all of the remaining unappropriated flow. The table shows flows remaining on these streams after the instream flows are subtracted. Since DFWP requested *all* of the remaining flow for each month of the year, the table should show zero remaining flow at the following: Bridger Creek near Bozeman, East Gallatin River at Bozeman, Rocky Creek near Bozeman, and Sourdough Creek near Bozeman. Also, in Table I-1 under the Madison River drainage, the same comment above applies to the following three streams: Beaver Creek near West Yellowstone, Cabin Creek near West Yellowstone, and West Fork Madison River near Cameron.

Response: The title of Appendix I should read "Average Monthly and Annual Flows Remaining after Requested Instream Flows or the Maximum Instream Flows Allowed by Statute are Subtracted." On Bridger Creek and the East Gallatin River at Bozeman, the instream flow requests were reduced to half the average annual flow before being subtracted, and the amounts presented in Table I-1 are correct. Mention is made in DFWP's application that all unappropriated water should remain in Rocky Creek and Sourdough Creek. Elsewhere in the application, however, and in the 610B R/788 forms that accompany a reservation application, DFWP requested flow rates of 51 cfs for Rocky Creek and 35.9 cfs for Sourdough Creek. The values listed in Table I-1 for these streams are correct.

Flows remaining for Beaver Creek, Cabin Creek, and the West Fork of the Madison in Table I-1 are incorrect. The values in Table I-1 have been corrected to reflect zero flows available after instream requests are subtracted. See "Changes to the Draft EIS."

130. **Comment:** On page I-4, under Jefferson River drainage, Black Sand Spring Creek is a Madison River tributary—not a tributary to the Jefferson—and the flows listed are incorrect. Halfway Creek and Willow Spring Creek flows are incorrect. Under the Big Hole River drainage, the flows are incorrect for Delano Creek or Rock Creek. Under the Beaverhead River and Red Rock River drainage, the flows for Poindexter Slough are incorrect. All of these flows are too low. DFWP can provide the correct numbers.

Response: The amounts listed in Table I-1 for these streams are correct. Your comment that Black Sand Creek is a Madison River tributary is noted. See "Changes to the Draft EIS."

131. **Comment:** On page I-7 under Marias River drainage, the flows for Badger Creek are incorrect (too low).

Response: The amounts listed in Table I-1 for this stream are correct.

132. **Comment:** On page I-8 under Musselshell River drainage, the flows for Collar Gulch Creek are incorrect (too low).

Response: The amounts listed in Table I-1 for this stream are correct.

133. **Comment:** On page 61, Table 4-12, last column, it appears that the fourth and fifth entries in that column are in error, since the same entries in column E are negative numbers that would indicate, in the last column, that the number 20 should be 18 and the number 32 should be -18.

Response: The numbers are correct. For example, the difference between a gain of 19 GWh per year at the 1955 level of development (LOD) and a loss of -1 GWh per year at the 1986 LOD is a total difference or decrease of 20 GWh per year between the two dates.

WATER STORAGE

EFFECTS OF INSTREAM RESERVATIONS ON STORAGE

134.69. **Comment:** Instream flow water reservations could prevent future upstream development of water for irrigation, storage, supplemental irrigation needs, or associated benefits such as additional instream flows for fishery, recreation, flood control, groundwater recharge, power generation, etc.

Response: Granting instream reservations in some instances could prevent the development of upstream irrigation and new storage that would require new water rights. The amounts of water unavailable would have to be determined on a site-specific basis. Appendix I in the draft EIS includes the average monthly and annual flows remaining by stream after instream flow requests are subtracted. Appendix I does not take into account the water that already might be appropriated by MPC, BUREC, BLM, and other senior water right holders. If these rights are adjudicated as claimed, water availability for storage will be severely limited.

135. **Comment:** Instream flow reservations in the volumes requested exempt any future offstream stor-

age development other than that currently applied for. This is in direct conflict with at least one stated objective in the water storage section of the Montana water plan recently adopted by the Montana Legislature.

Response: Appendix I of the draft EIS lists the average amounts of water available for future storage or other uses if the Board grants all instream requests in full or to the maximum amount allowed by statute. A review of the state water plan's water storage section uncovered no objectives that conflict with instream flow reservations.

136. **Comment:** Instream flows should be maintained through the development of new storage.

Response: No reservation applicants proposed new storage reservoirs to supply water to maintain instream flows. A site-specific analysis would be necessary to determine whether it would be feasible to build storage projects to satisfy instream flows.

137. **Comment:** DFWP maintains that the reservation is necessary to maintain quality angling, but the EIS fails to demonstrate how a reservation of high water with a 1985 priority date will ensure quality angling. If DFWP were granted a reservation of the unappropriated (high) water, it would have to store the water for later release to maintain the instream flow when senior rights have first call on the water.

Response: DFWP has requested year-round instream flows. There are no requirements in the reservation statutes that instream or other reservants store water to meet their reservation requests.

138. **Comment:** DFWP should build a reservoir to provide water for its instream flow request on the Musselshell River. How about a site near Ryegate?

Response: In its reservation application, DFWP did not propose to build a storage reservoir to supply water for its reservation requests on the Musselshell River.

139a. **Comment:** Instream flow rights, particularly in the headwater tributary streams to rivers, should be conditioned toward water conservation and storage projects that can contribute directly or indirectly to more stable instream flows throughout the year. The EIS should emphasize the upstream, offstream water conservation and storage impacts. Almost all of the scoping meetings held by DNRC evidenced the desire of the public to this end. The question of management and financing of projects for multiple uses should be more adequately addressed.

139b. **Comment:** It appears foolish to consider stream reservations. Storage should be considered instead. The draft EIS should consider further the matter of both kinds of water storage.

Response: MEPA requires DNRC to analyze the impacts of reservation requests as proposed and to evaluate the impacts of the proposed reservations or any other reasonably foreseeable actions. The only storage project in the Headwaters subbasin that met these criteria was that proposed by the City of Bozeman. DNRC also is required to analyze reasonable alternatives to the proposed action. New onstream and offstream storage projects in the Missouri River's headwaters have been studied and evaluated numerous times throughout the past 50 years. For example, because of low flow conditions in the Big Hole drainage, DNRC evaluated 120 potential storage sites during the 1970s. Twenty-two of these were studied in more detail between 1978 and 1982, and none were considered economically or financially feasible.

The Water Storage Financing Steering Committee spent more than a year during 1989-90 addressing the issue of financing water storage through the state water planning process. Because of this effort and those of the State Water Plan Advisory Council, Governor Stephens, and the legislature, significant changes were made for financing water storage projects during 1991. For example, a special water storage account was set up to fund water storage activities. The legislature also set a preference for using state funds: first preference to rehabilitate existing facilities, second preference to enlarge and rehabilitate existing facilities, and third preference to construct new storage projects. Further, the storage legislation requires DNRC and DFWP to initiate a study in 1991 to evaluate financing and management of storage projects for multiple use. For these reasons, DNRC did not feel it was again necessary to address multiple use, financing, and management of storage projects unless they concerned a specific project in one of the reservation applications or existing storage projects such as Canyon Ferry and Tiber reservoirs.

140. **Comment:** Ruby Reservoir and Clark Canyon Dam would store less water if the instream flow requests are granted by the Board.

Response: Instream reservations would have a July 1, 1985, priority date and would be junior to existing rights for storage in the Ruby and Clark Canyon reservoirs. They would not affect the storage, inflows, or outflows of these reservoirs.

141. **Comment:** I [Charles Hahnkamp] feel that all of the water in Cherry Creek and the Big Hole River is adequately used up. The only way to ensure instream flow would be to store water during flood waters.

It seems quite clear to me that we cannot acquire more water in the streams by making more claims on them.

Response: Comment noted. See response to comment 139.

GENERAL

142. **Comment:** The draft EIS does not address new storage.

Response: See pages 66-67 and 181-182 of the draft EIS.

143a. **Comment:** There is no mention of how to satisfy the water reservations when there is no water available for the reservations. Shouldn't we be looking at storage facilities to help satisfy these reservations?

Response: As with any other water right, when water is not available, reservations cannot be satisfied. A number of storage projects were included in conservation district reservation applications and are summarized in Table 6-7 of the draft EIS.

143b. **Comment**: If anyone wants more water, the only answer is to build more storage.

Response: Reservation requests that include storage projects are summarized in Table 6-7 of the draft EIS (p. 181). Your comment that applicants requesting reservations for more water should be required to build storage is noted.

144. **Comment:** It is estimated that it will cost $500 million to correct failures on existing state-owned dams in Montana. Irrigators cannot afford to pay these costs, which eventually will fall on the shoulders of the taxpayer. Additional water storage dams are not a viable alternative for irrigators.

Response: The current estimated cost for rehabilitating existing state-owned dams in Montana ranges between $100 and $150 million. Most of this cost is associated with repairs needed on the Tongue River Dam. The costs of rehabilitating dams are to be paid from revenue earned by selling water from state-owned dams. (This revenue comes from irrigators and municipalities that use the water, along with federal and state contributions.) This is briefly explained on page 67 of the draft EIS and in further detail in the state water plan's water storage section.

DNRC evaluated the feasibility of proposed irrigation storage projects. Five of the 15 proposed projects listed in Table 6-7 of the draft EIS (p. 181) are estimated to be at least economically feasible and financially marginally feasible with water in 8 of 10 years. These same projects, which are estimated to have higher consumptive values (dollars/acre-foot) when compared to instream flow values, have a positive net benefit. In some instances, storage projects may be viable.

145. **Comment:** The EIS should address the issue of storage in greater detail and its impacts, pro and con, including economics, social, and environmental. The question of management and financing for storage for multiple uses should be more adequately addressed as well as priorities in the public interest.

Response: The EIS addressed the impacts of the reservation applications on the existing environment. Those storage projects in the reservation applications and others proposed in the basin in the foreseeable future are discussed in Chapters Four and Six of the draft EIS.

146. **Comment:** The EIS (p. 45) states that the Clark Canyon Reservoir on the Beaverhead and other storage facilities create more uniform streamflows than would naturally occur, and that BUREC and DFWP have informal agreements to coordinate operations of Clark Canyon, etc., to benefit reservoir and stream fisheries, wildlife, and recreation (p. 59), and the recreational use of the Clark Canyon Reservoir and Beaverhead/Red Rock, Big Hole, and Ruby rivers.

Because the river was overappropriated and without adequate streamflows to satisfy the appropriations, the water users on the Beaverhead worked for years to get approval from Congress for the Clark Canyon Dam. Despite opposition from the then Fish and Game Department, the dam was constructed by BUREC and a minimum streamflow established where none existed before. The Beaverhead River now is one of Montana's premier trout streams.

If it weren't for the storage in the Clark Canyon Reservoir during the severe drought of the past five years, the Beaverhead River would have become dewatered and without water for either the water users or the fish by late summer.

Despite the drought, most of the water users survived along with most of the fish as a result of the dam.

Any reservation by DFWP would not have provided a minimum streamflow during dry years and will not solve its purpose, however commendable it may be, as all of the water has been appropriated and these appropriations are to be protected both by statute and constitution.

Response: Storage in Clark Canyon Reservoir has provided instream flows that have benefitted the local fishery during dry years. The instream flow reservations as requested would not alleviate existing problems during dry years.

147. **Comment:** How will the reservation requests affect the operation, releases, and levels of Fort Peck Reservoir?

Response: In general, the reservations would have small effects on Fort Peck Reservoir. Based on the 1929-to-1986 period of record, these effects would be greatest under the Consumptive Use Alternative, where average annual electricity production would be reduced by 3.5 percent, average annual reservoir contents would be reduced by 0.3 percent, and average annual reservoir elevations would drop about 1 foot. In the driest year out of 10, annual energy production would be reduced by 3.8 percent, reservoir contents would be reduced by 0.5 percent, and reservoir elevations would still drop by about 1 foot.

148. **Comment:** The draft EIS does not adequately address pending federal decisions on proposed water reservations. There is no discussion as to pending water use from Fort Peck Reservoir for power generation and required barge flow on the Mississippi. Federal action may well limit upstream water use.

Response: To speculate on the outcome of any pending federal decisions is beyond the scope of this EIS. The effects of the reservation requests on hydropower production at Fort Peck Dam and major downstream dams were addressed in Chapter Six under "Power Production" (p. 230). Also considered beyond the scope of this EIS is an assessment of flow for downstream barge traffic.

149. **Comment:** Glacier County is encouraging industry to relocate here to stimulate the economy and keep life at a reasonable level. We [Glacier County Conservation District] need water to be able to encourage life of any type. Granted, the instream flow is needed for hydroelectric power. If left to Mother Nature alone without interference of man, most water would disappear as high instream flows during high runoff, leaving much lesser amounts of water for instream flows during the low precipitation and low snowmelt seasons of the year, thus defeating the purposes of more stable water availability throughout the year (for all uses) that diversionary uses now help to mitigate.

Consumptive uses have very little impact on instream flow during periods of high runoff. It is during the low precipitation periods of the year that consumptive use has an impact only because most of the water has run away and what is left is overappropriated.

So what is the answer? Storing water upstream, is it not? Irrigators on tributary streams generally always are short of water during low precipitation times and greatly in need of supplemental water to satisfy their rights. This only has an impact on instream flows and other uses that only storage with proper management can mitigate.

Response: See responses to comment 139 on storage and comments 64 and 70 for the effects of consumptive use on streamflows.

150. **Comment:** On page S-4 is the statement that "Stored water could be released from Tiber Reservoir to offset most water depletions in the lower Marias River." Similar statements are made on pages 239-241. No commitments have been made to use stored water for this purpose, and it may not be available in the future. BUREC's Lower Marias Unit must be operated in accordance with congressionally authorized purposes.

Response: DNRC recognizes that no commitments have been made on how water stored in Tiber Reservoir might be used in the future. DNRC examined the use of water stored in Tiber as a means of offsetting depletions elsewhere in the basin. The original irrigation project used to justify construction of the reservoir has not been built, but a modified version of it is included in the Big Sandy Conservation District's water reservation application (BSS-2). Congressional action probably would be necessary before such a change in operations would take place.

151. **Comment:** Reservoirs on the Beaverhead and Madison rivers have contributed to the cooler water temperatures required by cold-water aquatic life. A study by DFWP on the Beaverhead concluded that flow depletion caused much less warming of river water than was caused by high air temperatures.

Response: The comment generally is correct. Solar warming of water in Ennis Lake, however, has caused water temperatures in the Madison River below the reservoir to sometimes reach levels lethal to trout.

WATER QUALITY

ARSENIC

152. **Comment:** It is not clear from the discussion on page 69 of the draft EIS whether the Board of Health and Environmental Sciences intends to retain the 20 nanograms/liter arsenic standard or adopt a revised EPA standard when available. The standard adopted by the state will be a critical factor in determining whether arsenic concentrations in waters of the upper Missouri basin are in compliance with state standards. The basis for the state's standard should be explained.

Response: The Board of Health adopted the recommended EPA instream standard for arsenic in 1988; this level was 2.2 nanograms/liter. Subsequently, the EPA revised the level upward to 20 nanograms per liter. As of December 1991, the Board of Health has not adopted the revised 20 nanogram level. Because either concentration is very small, whichever is used makes little difference in interpreting the instream standard.

153. **Comment:** What is the source of arsenic in the Missouri drainage?

Response: See page 69 of the draft EIS.

154. **Comment:** The draft EIS does not identify ways to treat water at its source to remove arsenic.

Response: Arsenic can be removed from a water source through a number of ways. Individual families can treat arsenic with a reverse osmosis system at a cost of about $500 for the system and $200 for annual maintenance. According to DHES (1991), the cost to treat a major portion of the Madison River—the primary source of the arsenic—would be hundreds of millions of dollars. This system would consist of a coagulation, sedimentation, filtration, and reverse osmosis treatment facility that would be able to treat only the 60 to 70 percentile flow. Because this system would remove beneficial nutrients and biota, nutrients and biota would have to be added to the river at additional cost to sustain a fishery and river ecosystem. If the drinking water standard is reduced from 50 micrograms/liter to a lower number, as suggested by EPA, some of the municipalities that depend on Missouri River water upstream from Fort Peck Reservoir may have to modify their treatment facilities to meet this new standard. It is impossible to project these costs at this time.

155. **Comment:** Perhaps a filtration system installed at the Madison Dam below Ennis Lake or a similar site that only filters a portion of the river flow to remove arsenic—leaving a portion in its natural state as regarding the bio-organic life, etc.—would be a means to lowering arsenic levels and allowing for more water consumption and reservation. I am suggesting filters such as those that "Chromato Chem" in Missoula now is working on developing. Perhaps a filtering station could be sited on the Gallatin, too. It would seem that perhaps federal funding might be available for such a project.

Response: Treating water and returning it to the Madison or Missouri river channels for subsequent downstream use (domestic, instream, or consumptive uses) are impractical for several reasons. During the summer and winter months when arsenic concentrations are highest (80 micrograms/liter) and streamflow is lowest (1,500 cfs), most of the flow would require treatment to substantially affect downstream arsenic concentration. For example, to reduce the concentration to the federal drinking water standard (50 micrograms/liter) would require the diversion and treatment (complete removal of arsenic) of 940 cfs, equal to 63 percent of the river's flow. The cost to treat this volume of flow is prohibitive, and the effect on overall water quality (removal of other constituents essential to a healthy aquatic environment) would be deleterious.

Water treatment to remove arsenic currently is practiced on a small scale (individual domestic supplies) in the Madison drainage. There, commercially available, reverse-osmosis units are used to treat small volumes of water for household use.

The Gallatin River does not have elevated concentrations of arsenic.

156. **Comment:** How much more skin cancer is caused by arsenic in the drinking water in Great Falls than in Billings?

Response: Arsenic concentrations in the Missouri River near Great Falls typically are 20 micrograms/liter, compared with 10 micrograms/liter in the Yellowstone River near Billings. Arsenic concentrations in the Great Falls municipal water supply—serving a population of about 72,000—are about 10 micrograms/liter after treatment. Billings serves a similar population, but no data are available on arsenic concentrations in treated water supplies. If conventional treatment reduces Billings concentrations by 50 percent (from 10 to 5 micrograms/liter), the fraction of skin cancer due to arsenic in public water supplies would be roughly one-half that in Great Falls.

157. **Comment:** The high arsenic concentrations in the Missouri River are a major "stumbling block" for future consumptive uses.

Response: High arsenic concentrations in the Missouri River present a substantial human health risk and already exceed federal and state standards. Increased arsenic concentrations and health risks are costs associated with further consumptive depletions. The Board will have to determine what level of consumptive depletion, if any, is in the public interest.

158. **Comment:** There should have been an instream flow alternative that would deny all future uses if they could increase the already-high arsenic concentrations.

Response: An instream flow alternative is presented and analyzed in Chapter Two of this EIS.

159. **Comment:** Because the concentration of arsenic already is so high in the Madison and Missouri rivers, DHES should not be limited to half of the recorded average annual streamflow.

Response: By law, the Board cannot grant reservations of water for instream flows that exceed one-half the average annual flow of record on gauged streams (§ 85-2-316(6), MCA).

160. **Comment:** The draft EIS discusses the arsenic issue in a qualitative manner. This approach was expected in light of the extremely rigorous 2.2 nanograms/liter standard the state has elected to adopt. Even if DHES's request to reserve one-half the average annual flow of the Missouri River at Toston, Ulm, Virgelle, and Landusky were granted, the 2.2 nanograms/liter state standard would not be met since upper Missouri waters presently are in a noncompliance status due to naturally occurring, elevated arsenic concentrations. Therefore, recognizing that enforcement of the arsenic standard is impossible, DHES should consider amending its reservation claim to reflect that realistic flows are required to protect human health and maintain water quality in concert with EPA public water supply criteria. Results of the interagency arsenic modeling effort would provide quantification as to the extent and magnitude various water diversion scenarios may have on upper Missouri arsenic concentrations. Model results then could be applied to an enforceable and detectible arsenic standard as recognized by EPA.

Response: An important goal of the ambient surface water standard for arsenic is to prevent further degradation where existing arsenic concentrations exceed 2.2 nanograms/liter. No technical or legal limitations prevent enforcement of the standard. The ongoing interagency arsenic modeling effort will provide additional insights into the effect of resource management on arsenic water quality. Revision or modification of state and federal arsenic water quality standards is beyond the scope of the EIS. The Board is limited by law to granting DHES and all other instream reservants a maximum of one-half the average annual flow on gauged streams.

161. **Comment:** The arsenic and salt problems brought on by irrigation are poor treatments of the land and should not be allowed to continue.

Response: Refer to the "Water Quality" section (p. 68) in Chapter Four of the draft EIS for a discussion of existing arsenic and salinity problems in the Missouri basin. Reservations for instream flows would not correct existing arsenic problems.

162. **Comment:** The draft EIS inadequately addresses arsenic contamination. The data on the carcinogenicity of arsenic still are subject to debate. Arsenic concentrations at each reservation location need to be delineated pre- and post-reservation. Removing heavily arsenic-laden waters for treatment, impounding, or irrigation could have a beneficial effect basinwide.

Response: DNRC recognizes the uncertainty concerning health risks from arsenic ingestion. DHES has informed DNRC that the basis for establishing the "1 per million" risk level for arsenic is adequate (DHES 1989). As the state government water quality agency, DHES sets standards with EPA oversight.

The state legally is bound to comply with the arsenic standard. There is not sufficient data available to analyze arsenic concentrations at each reservation location. Economic costs of large-scale water treatment to remove arsenic are prohibitive. Irrigating with or storing arsenic-laden water may alter the seasonal concentration of arsenic and cause local, short-term decreases in arsenic concentrations. In general, consumptive use and evaporation from storage will increase arsenic concentrations on an average annual basis.

163. **Comment:** The draft EIS does not state where arsenic reaches acceptable limits on the Missouri River.

Response: Arsenic concentrations in the Madison and Missouri rivers exceed the state surface water standard (2.2 nanograms/liter) at all points in Montana; arsenic concentrations in the Madison River commonly exceed the state drinking water standard (50 micrograms/liter). In the Missouri River between Three Forks and Canyon Ferry Reservoir, arsenic concentrations are elevated near the drinking water standard in summer months. Only the Missouri below Canyon Ferry and most tributaries are in compliance with the drinking water standard on a year-round basis. Only the tributary streams with no natural sources of arsenic are in compliance with the surface water standard.

164. **Comment:** In Chapter Two, the draft EIS needs to clarify the inter-relationship between State of Montana water quality standards and the arsenic issue. The Montana Water Quality Act's surface water quality standards and water use classification system states:

> . . . Department of Health and Environmental Sciences (DHES) has adopted water quality standards that establish maximum allowable changes in surface water quality parameters for each stream on the basis of its classification.

It is not entirely clear from this discussion whether the water use classification system is based strictly on existing beneficial uses of the state's waterways, or whether additional criteria are used in the classification. If degradation of a stream were to occur, what is the magnitude of the maximum allowable change in surface water quality parameters for each stream? And do the allowable changes preclude a change in a stream's water use classification? We [BUREC] request that the state provide additional information regarding how the "non-degradation rules" established by the Montana Board of Health and Environmental Sciences (BHES) (p. 10) and the Board's instream standard (that does not allow activities that increase arsenic concentrations beyond 10 nanograms/liter) interface with the "maximum allowable changes" for surface water quality promulgated by DHES.

Response: The State of Montana water quality classification system is based on existing beneficial uses and a number of water quality criteria. Maximum allowable changes in surface water quality parameters are based on whether such changes allow maintenance of existing beneficial uses. An action violates the water quality standard if existing beneficial uses are adversely affected. Any reservation or appropriation of water that results in a depletion in the average flow of the Madison or Missouri rivers will violate the Montana Surface Water Quality Standards (16.20.618(h)) and the Montana Non-degradation Rules (16.20.701 et seq.). Taken together, these two sets of rules prohibit increases in the concentration of substances for which there are drinking water limits (16.20.618(h)(i)) and for "deleterious substances."

For contaminants that have a Maximum Contaminant Level (MCL) set by EPA, degradation means that the concentration of that contaminant has increased. For contaminants for which there is no MCL, the concentration must increase, and the presence of the contaminant in the water must adversely affect an existing or future beneficial use before it is considered degradation (ARM 16.20.1011(2)).

Arsenic clearly falls in both categories. Since depletions will cause an increase in the arsenic concentrations in the Madison and Missouri rivers and will result in an increase in the expected number of cancers in the population that is dependent on these rivers for its drinking water supply, any such depletions will violate state law.

165. **Comment:** Page 188 of the draft EIS states that an increase in arsenic concentrations in the Milk River from 4 micrograms/liter to 6 micrograms/liter would violate the BHES surface water instream standard of 2.2 nanograms/liter. The initial 4 micrograms/liter level already is in violation of this standard. The discussion should be revised to recognize the 2.2 nanograms/liter standard.

Response: In surface water that already exceeds 2.2 nanograms/liter, no further increase in arsenic concentration is allowed. Therefore, an increase from 4 to 6 micrograms/liter in the Milk River as a result of interbasin transfer of Missouri River water would be a violation of the state's surface water standard.

166. **Comment:** In our [BUREC] view, the draft EIS poses a potential critical dilemma. Water quality standards and constraints adopted by DHES and BHES and promulgated in the Montana Water Use Act and Montana Water Quality Act could, in fact, preclude much of the proposed activity under the water reservation process. Page 134 of the draft EIS states: "The concentration of arsenic in the Madison and Missouri rivers far exceeds the state instream water quality standard." Few of the proposed consumptive use projects could be operated without further violating this standard. This situation could undermine the state's claim for consumptive use reservations in the Missouri River and restrict Montana's share of water to instream augmentation (instream flow).

Response: DNRC agrees that the arsenic standards defined under the Federal Clean Water Act and the standard adopted by BHES pose a dilemma for additional consumptive uses of water in the Missouri River basin. If BHES had not adopted a standard that complies with federal instream guidelines (20 nanograms/liter), EPA would adopt and enforce it within Montana as it has done in other states.

When the Montana Legislature passed the Missouri River reservation statute, little information was available on the high concentrations of arsenic in the Missouri River basin.

167. **Comment:** It seems unconscionable to export arsenic to the Milk River basin. Won't this create problems there that don't exist now?

Response: See pages 187-188 of the draft EIS.

168. **Comment:** DHES's reservation for arsenic dilution is based on questionable, unproved, theoretical projections of the incidence of skin cancer caused by arsenic. DHES has not proved the need for the amount of water required to obtain the desired dilution. DHES has not shown there is an epidemic of skin cancer among domestic water users on the Missouri River. DHES has not shown there is a higher incidence of skin cancer in the domestic water user on the Missouri than on the Yellowstone River.

Response: DHES and EPA believe that data relating arsenic ingestion to occurrence of skin cancer are adequate to set standards. Detailed epidemiological studies have not been conducted in the Madison/Missouri basin, largely because of the expenses and problems involved with designing such a study.

169. **Comment:** Is the information provided by DHES accurate and long-lasting? Technology and standards change.

Response: Water quality data provided by DHES and the U.S. Geological Survey are collected and analyzed by standard methods to ensure reliability. The data, however, especially for trace elements such as arsenic, are expensive to collect. This limits the frequency and geographic scope of water quality data collection and makes prediction of arsenic impacts difficult. It is not possible to predict whether arsenic standards will change in the future. (See response to comment 152.)

170. **Comment:** The reservation request of DHES is based on the premise that instream flows are necessary to reduce the concentrations of water pollutants [arsenic]. The Teton County Conservation District feels that the final EIS would include alternatives to dilution of pollutants, including improved treatment of withdrawals from the basin, use of existing water storage facilities to act as pollutant traps, construction of artificial wetlands to act as pollutant traps, and another feasible alternative to the preferred method of dilution through maintenance of instream flow. The analysis of these alternatives should include not only the cost of the alternatives, but also the cost of not providing for development of other reservation requests.

Response: DNRC and DHES have examined a variety of alternatives for management of arsenic concentrations. Maintenance of dilution flows appears to be the only cost-effective method and is required to comply with recent changes in state and federal water quality standards for arsenic. DNRC and DHES have examined and continue to investigate a variety of ways to reduce health risks associated with arsenic ingestion in the Missouri basin. The alternatives are briefly described below.

Water Treatment near Source: Treating surface flow to reduce basinwide arsenic concentrations appears to be impractical because of the relatively large volume of flow, even near the source of arsenic (see response to comment 155). In addition to costing several hundred million dollars, the most effective treatment methods would remove other nutrients and chemical constituents and alter downstream water quality, which are critical for maintaining aquatic habitat and the fishery in the Madison River. Further, arsenic in stream channels, reservoir sediments, and shallow groundwater in the Madison Valley would remain to contaminate streamflows downstream of the treatment facility.

Domestic Treatment: Individual household treatment systems work by distillation or reverse osmosis and are capable of achieving arsenic concentrations of 1 microgram/liter. These are available at an initial cost of about $500 each and require about $200 of annual maintenance.

Municipal Treatment Facilities: Upgrading municipal facilities to reduce arsenic concentrations would lower health risks for domestic users relying on municipal facilities; rural water users would not benefit. Reliable estimates of the cost of upgrading existing treatment facilities to meet a particular arsenic concentration level presently are not available. Each municipal system is unique in design and operational characteristics and would require a preliminary engineering design/feasibility study to arrive at the increased treatment costs. This was not possible within the time and funding constraints of the EIS.

Pollutant Traps: All reservoirs on the Madison and Missouri rivers trap and store sediment and associated arsenic. Based on preliminary studies, the existing reservoir sediments contain arsenic at or near stream sediment levels found upstream and downstream of the reservoirs. The effect of reservoir operations on sediment and arsenic storage is poorly understood, but it is unlikely that any of the reservoirs could be managed solely for arsenic reduction in downstream water supplies.

The creation of artificial wetlands provides a way to trap arsenic associated with sediments but would allow dissolved arsenic (most arsenic in the Missouri basin above Canyon Ferry is dissolved) to pass. In addition, the intentional creation of wetlands using arsenic-contaminated water and sediments may create further problems.

171. **Comment:** While researching the question of arsenic levels in the water, I [Dixie Nugent] found that proposed projects would not affect this problem. Again, since the water reservation only concerns excess water flow, it would in no way affect the current concentration. There are several lakes between Yellowstone Park and Great Falls that might serve as settling ponds for the arsenic. This is an area that definitely needs much more research. The Great Falls Water Treatment Plant tells me that the federal maximum contaminant level is 50 parts per billion (ppb) for arsenic. When the water has been processed at the plant, it is at 13 ppb. This is well below the accepted rate. The reference to cancer-causing agents also needs to be examined much closer. According to the same water treatment plant, there is no federal standard; it is too hard to measure. In addition to drinking arsenic-laden water, you would have to eat one ounce of arsenic-laden fish every day of your life to contract cancer. Based on the table for the Cascade County Conservation District, it was determined that the proposed projects would not have any impact on heavy metals and current arsenic levels.

Response: See responses to comments 163, 170, and 173.

172. **Comment:** Each project, such as the Virgelle diversion project, should be addressed on whether arsenic concentration would increase.

Response: In general, all projects that deplete surface flows will increase arsenic concentrations to some degree. The Virgelle diversion project would divert arsenic-laden water from the Missouri River (median concentration 15 micrograms/liter) into the Milk River (median concentration 3 micrograms/liter), increasing the concentration of arsenic in the Milk River.

173. **Comment:** How will direct diversions from the Missouri River for consumptive uses increase arsenic concentrations?

Response: Direct diversions from the Missouri River for consumptive uses will influence arsenic concentrations in three principal ways. First, projects that apply water to well-drained, coarse-textured soils will generate return flows with elevated arsenic concentrations and thereby increase arsenic concentrations in the Missouri River. In this situation, the same amount of arsenic will return to the river as was removed, but will be concentrated. This is because water is lost by evaporation and plant use during irrigation, but arsenic generally is not.

In the second situation, projects that irrigate fine-textured soils with a particular combination of clay mineralogy and metallic oxides (aluminum, iron, etc.) will store arsenic temporarily (months) or over the long term (years). Soils that store arsenic will continue to do so until storage sites are filled or until changing geochemical conditions favor remobilization of arsenic. While the arsenic is stored, return flows with reduced arsenic concentrations will enter the Missouri River, and arsenic concentrations in the river as a whole will be slightly reduced.

In cases where Missouri River water is supplied to parcels far removed and not hydraulically connected to the Missouri River, diverted arsenic and water may never return to the Missouri River. These projects would cause little change in Missouri River arsenic concentrations, although the total load in the river would decline.

SUSPENDED SEDIMENT

174. **Comment:** Suspended sediments caused by irrigation return flows are not adequately addressed.

Response: When the amount of water applied to a field for irrigation exceeds that which can be absorbed by the soil, water will begin to flow on the surface. Some of this water, or "surface return flows," may eventually reach a stream or stream channel either directly or via canals. Surface return flows also may erode sediment from fields and canals and transport it to a stream. See Table 6-14 of the draft EIS for a list of projects with canals.

Most of the irrigation projects proposed by the conservation districts would involve efficient sprinkler irrigation systems. With these systems, surface return flows would be small, as application rates can be controlled so as not to exceed the rate at which the soil can absorb water. A few sprinkler irrigation systems on steep slopes may create localized sediment problems. Project LCI-20 is the only such project identified by DNRC. It would contribute sediment to the Dearborn River.

For flood irrigation systems, excess water often is applied at the head of a field to ensure that adequate water reaches crops at the lower end. Sediment could be eroded and carried to a stream by this excess water. Table 3-7 summarizes proposed flood irrigation projects that may add sediment to streams.

Table 3-7. Irrigation projects that may add sediment to streams

Project	Acres to be flood irrigated	Stream that would be affected	Comments
BR-29	30	Deep Creek	May contribute some sediment to Deep Creek.
BR-101	987[a]	Jefferson & Missouri rivers	Highly erosive soils on this project are likely to contribute suspended sediment to proposed canal system. Flow from canals will enter three small stream channels. Erosion in these three channels will generate more sediment before the water returns to the Jefferson and Missouri rivers.
BR-104	1,829[a]	Duck Creek	Suspended sediment from fields and the proposed canal within the project will enter the channel of Duck Creek approximately one mile upstream from its confluence with Canyon Ferry Reservoir.
GA-35	30	Gallatin River	Surface return flows and sediment from this project could reach the Gallatin River.
CS-42	124	Belt Creek	Surface return flows and sediment from this project would enter Belt Creek.
CHI-52	73	Marias River	Surface return flows and sediment from this project would enter the Marias River.
GL-201	86	Whitetail Creek	Surface return flows and sediment from this project would enter Whitetail Creek.
JB-261	21	Running Wolf Creek	Surface return flows and sediment from this project would enter Running Wolf Creek.
JB-281	10	Otter Creek	Surface return flows and sediment from this project would enter Otter Creek.
JV-201	1,253[a]	Jefferson River	Surface return flows and sediment would move down small stream channels, eventually reaching the Jefferson River.
JV-202	1,485[a]	Jefferson River	Surface return flows and sediment would move down small stream channels, eventually reaching the Jefferson River.
JV-203	530[a]	Jefferson River	Surface return flows and sediment would move down small stream channels, eventually reaching the Jefferson River. Some project soils are highly erodible.

[a] Acres included are only those that would be flood irrigated. These projects include other land that would be sprinkler irrigated.

Sediment that blankets stream bottoms can damage invertebrate populations and block spawning gravels, preventing the successful development of fish eggs and larvae (U.S. Environmental Protection Agency 1986).

175. **Comment:** I [Trout Unlimited] have some concerns about water quality. Discussion is very sparse in the draft EIS about pollution by total suspended solids (sedimentation). Sediment could be a major pollutant coming off many of the projects. Beyond acknowledging the severe sedimentation problem in Muddy Creek caused by return flows from Greenfields Irrigation District (p. 187), there is little discussion of sedimentation. Yet on a number of occasions in the individual project environmental assessments, you allude to sedimentation as one of the adverse consequences of irrigation projects.

One example in particular illustrates the point especially well. The environmental assessment for Lewis and Clark County Conservation District indicates that LCI-20 on the Dearborn River will have moderately adverse impacts of turbidity (sedimentation) and moderate impacts on fish habitat. Beyond the obvious dewatering problem caused by more withdrawals from the Dearborn, increased sedimentation will likely degrade spawning habitat in what is one of the most important rainbow spawning tributaries of the Missouri. The draft EIS should specifically address this problem. Further, it specifically should examine the influence of other projects on sedimentation. It also should discuss in more general terms the impact of sedimentation on water quality and fisheries habitat.

Response: Total suspended solids (TSS) data are reported irregularly at USGS monitoring stations and on only a few tributaries in the Missouri basin. Montana water quality standards limit TSS to protect beneficial uses for aquatic life but not for public water supplies. Since no agency regularly gathers TSS data, sufficient data is lacking to analyze each project's effect on sedimentation. Further, sedimentation is a natural process accelerated by human and animal activities, and often its adverse impacts are not recognized or readily apparent. The Dearborn River is listed in the upper Missouri subbasin as one of several tributaries to the Missouri River with a sedimentation problem (see p. 72 of the draft EIS and Appendix E). Sedimentation, erosion, and turbidity caused by individual projects are identified on pages S-3, 37, 68, 70, 72-73, 76, 89, 90-95, 98, 102, 182, 184, 186-189, 191-195, 202, 211, 224, 242-243, Tables 2-2, 4-19, and in Appendix E of the draft EIS. Also see response to comment 174.

176. **Comment:** I believe if we [Cascade County Conservation District] were granted water reservations, it would be up to us to set certain standards for issuing the projects. Of course, 310s (permits required of project developers under the Montana Streambed Preservation Act) would come into play with any disturbance in or near a streambed. This would mean that some projects might not pass our criterion. We also have rules about replacing vegetation when any is disturbed near a streambed. We must keep the land from eroding. The conservation district would be willing to mandate each producer granted a water reservation the assistance to develop an intensive irrigation water management plan that addresses nutrient and pesticide management. Plans such as these help attain the goals of all parties concerned with this issue and are directly related to the mission of the conservation district. Best management practices are the key to these plans and by utilizing information available from SCS and the university system, the plan basically could guarantee that any water quality hazard due to these proposed projects would be kept to an absolute minimum. Many projects actually could enhance the water quality concern if these plans are implemented. We must realize that if we do not control the use of this water with great care, we will just be in the "water giving away business." I truly believe that with the right planning and rules we can preserve, protect, and utilize our natural resources.

Response: DNRC agrees that the measures stated above, if implemented, could reduce impacts associated with the conservation districts' water reservation requests. The Board could consider requiring such plans.

PROJECT LM-20

177. **Comment:** Discharging pentachlorophenol found in the coal mine (Project LM-20) to the Musselshell River could be avoided if this water is pumped directly to fields for irrigation.

Response: Discharging water containing pentachlorophenol to fields for irrigation is likely to cause increased concentrations of the materials in the groundwater supply. Irrigation return flows and surface water runoff containing this carcinogen also would contaminate nearby streams and eventually adversely affect the Musselshell River. Discharge of this material would require permits from DHES and likely would require treatment prior to discharge.

178. **Comment:** The Roundup mine project cannot be done because of water quality.

Response: Please refer to response to comment 177 and to page 188 in the draft EIS.

OTHER

179. **Comment:** Since water quality of the Musselshell River is so poor, is it desirable for DFWP to reserve an instream flow reservation for fish and wildlife?

Response: According to DHES (1985), water quality is moderately impaired along 309 miles of the Musselshell River below the Deadman's Basin Reservoir diversion. Causes of impairment include sediment, salts, nutrients, streambank erosion, grazing, and flow alteration from irrigation.

Fewer trout are found below Deadman's Basin Reservoir diversion; however, the river is used by other fish species more tolerant of this impaired water quality. These species are indicated in Appendix G of the draft EIS. DFWP (1989) reported a spring spawning run of channel catfish and possibly sauger from Fort Peck Reservoir up the lower portion of the Musselshell River. The spawning migration extends upstream at least as far as the Musselshell diversion. Sauger ripe for spawning have been found in the Musselshell in May. Evidently, DFWP felt that the fishery in the Musselshell River, including the lower portion of the river, warranted an instream flow reservation.

180. **Comment:** The draft EIS does not adequately address the very high quality of Big Spring Creek and its potential uses.

Response: Big Spring Creek is different from most Montana streams in that it is mostly spring-fed from a limestone aquifer, which discharges large volumes of high-quality water into the creek. Big Spring Creek is 44 miles long and suffers from naturally unstable streambanks, housing development along the stream channel, agricultural activities, flood control dikes, sewage treatment, and industrial discharge into the stream. In Fergus County, Big Spring Creek is classified B-1/B-2 by DHES. This classification means that the stream could absorb additional impairments such as increased sediment from unstable streambanks, changes in pH, or nutrients from agricultural or municipal activities before it would substantially deteriorate. Overall comparison of this stream with most upper Missouri River streams does not distinguish Big Spring Creek as "A-1" or among the highest quality streams as classified by DHES (see Appendix E of the draft EIS for all classifications). Big Spring serves as the water source for the City of Lewistown and a growing water bottling company.

181. **Comment:** In the draft EIS, inadequate impact consideration is given to the quality of water being reserved. Water that is anticipated for municipal use is lumped in with that required for irrigation, stock watering, and maintaining instream flows.

Response: For discussions of existing water quality in the Missouri basin, see pages 68-70 and Appendix E of the draft EIS. For a discussion of the effects reservations would have on water quality, see pages 182-188 of the draft EIS. Granting instream flow reservations will not change existing water quality.

182. **Comment:** The draft EIS does not adequately address the quality of water that would be discharged from the municipal project. It is conceivable that water quality might even improve after municipal treatment, thus improving water quality downstream in the basin.

Response: DNRC recognizes that properly treated wastewater could help dilute pollutants in some surface water and groundwater discharge areas (see p. 72 of the draft EIS).

183. **Comment:** A strong case is presented in the report for the need to prevent further concentrations of arsenic in Missouri basin streams. Similar concern is expressed for inorganic chemical pollutants. Potential water quality degradation in the subbasins due to pesticides is mentioned only in passing. In view of the substantial percentage of consumptive water use attributed to irrigated agriculture and projected water reservations resulting from future irrigation development, a more detailed discussion of pesticide levels and anticipated impacts should be included.

Response: DNRC considered pesticide mobility in a computer model that considered soils, cropping systems, irrigation, shallow bedrock, shallow groundwater, and types of pesticides. This modeling effort identified projects that have the potential to cause pesticide contamination. Table 6-9 of the draft EIS

(p. 184) lists potential problem projects. Data on existing pesticide levels throughout the four subbasins are limited; consequently, the level of increase in pesticide contamination as a result of reservation projects cannot be determined.

184. **Comment:** Categories B-1 and B-2 listed on page 8 of the draft EIS, Table 2-1, under Montana water classifications for specific uses, appear to be the same. The classification of B-1 and B-2 waters should be corrected.

Response: In Table 2-1 on page 8 of the draft EIS, no distinction is made between classifications B-1 and B-2. Table 2-1 describes specific uses of classified streams and not the variable standards of the stream classification. In general, the B-1 classification is a higher classification than B-2 and has more restrictive standards for parameters such as temperature, dissolved oxygen, turbidity, Ph, toxicity, and metals. These distinguishing standards for all of the classifications are found in pages 16-935 through 16-967 of ARM 16.20.603 through 624, Surface Water Quality Standards, State of Montana. No distinction IS made between the specific uses of B-1 and B-2 classified streams, although a distinction is made among the allowable parameters in streams of each classification.

185. **Comment:** We [Medicine River Canoe Club] feel that DFWP's requests do not provide for adequate levels of water quality. There is a tremendous problem in many of our rivers with nonpoint source pollution. We need adequate flows to dilute these pollutants. We suspect that if rivers flowed for extended periods only at levels requested by DFWP, these pollutants would not be appropriately diluted.

Response: DFWP based most of its water reservation requests on streamflows necessary to maintain certain aspects of aquatic habitat, not those needed to dilute pollutants.

186. **Comment:** The [Montana Wildlife] Federation feels that the final EIS should follow the intent of the Clean Water Act (§ 75-5-503, MCA), which deals with maintaining water quality. With the amount of herbicides and fertilizers draining into the basin each year, increased water flows are needed to comply with the Clean Water Act.

Response: In general, reservations would not increase flows. Instream reservations would help maintain flows, while consumptive reservations would decrease flows. See response to comment 187.

187. **Comment:** The draft EIS should address the influence of the nondegradation provisions of the Clean Water Act. Section 75-5-503, MCA, says, in pertinent part:

> . . . the board [of Health and Environmental Sciences] shall require . . . that any state waters whose existing quality is higher than the established water quality standards be maintained at that high quality unless it has been affirmatively demonstrated to the board that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of these waters . . .

It appears that many of the proposed consumptive use projects might be covered by this section. If so, how would this requirement affect the feasibility of these projects? And what is it likely to do to the cost-benefit ratio of those projects? Can they be allowed at all without some BHES approval? Given recent publicity over the nondegradation section, it is especially appropriate for the draft EIS to address its influence on this process.

Response: See pages 7-10 and S-6 and S-7 of the draft EIS, along with Chapter Seven, for the Board's responsibilities concerning water reservations. Refer to page 5 for an explanation of beneficial uses under Montana water law. The arsenic issue is addressed on pages S-3, 69, 184, 186, and 188, and in Tables 4-18 (p. 69), 4-19 (p. 71), and 6-12 (p. 188).

LAND USE

188. **Comment:** Page 196 of the draft EIS states the following:

> Montana cattle numbers are projected to remain stable (or decline slightly), while beef production efficiency is expected to increase (USDA 1989), reducing the demand for alfalfa.

If the numbers remain stable, the demand for alfalfa certainly would not decline.

Response: As described in the draft EIS (pp. 196-97), the average production of Missouri basin irrigated alfalfa is expected to increase from about 3 tons per acre to almost 4 tons per acre over the next

30 years. Beef cattle breeding is continuing to improve cattle feeding efficiency that uses less silage and feedstocks (particularly alfalfa and hay) to produce larger animals (USDA 1989). Finally, beef demand is expected to stabilize during the coming decades. The net effect of these three factors—(1) increasing alfalfa productivity, (2) improved livestock feed efficiency, and (3) stable beef demand—will be to put substantial downward pressure on alfalfa production. The U.S. Department of Agriculture (1989) projects that alfalfa needs will decrease by more than 40 percent over the next 40 years.

189. **Comment:** Gallatin County Conservation District questions the methodology used by DNRC to establish values for water for various uses. In the section on the agricultural economy, the writers say there will be a gradual decrease in irrigated land, due evidently to development. The District feels this is a positive reason for the Board to grant the District's application for water for irrigation. As this land is being developed in and around Bozeman, water formerly used for irrigation will become available for other uses.

Response: The agricultural economy section does indicate that the amount of irrigated land in the basin is likely to decrease gradually, along with the percentage of agricultural employment (see responses to comments 269 and 188). Long-term irrigation declines (U.S. Department of Agriculture 1989) and further residential developments in the Gallatin valley could make some current irrigation water available for other uses.

FISHERIES

METHODS

190a. **Comment:** The [Hill County Conservation] District is concerned about the methodology used in determining factors such as instream flows, etc., and why different methods of calculating these factors were not used. These different methods of calculation could have been used in comparison with one another for a more balanced look at the water availability of a particular water source.

190b. **Comment:** The EIS should address in greater detail the different methodologies that may be used to determine instream flows. Granted, it would be impossible to conclude as to the result of each methodology, but does the methodology chosen have some basis, or was it chosen on the basis of it resulting in the highest yield?

190c. **Comment:** Why did DNRC use the WETP method rather than some other method to calculate the instream flows necessary for instream purposes?

190d. **Comment:** The WETP method used by DFWP produces recommendations for too much water for instream use.

190e. **Comment:** The EIS should address in greater detail the different methods that can be used to determine instream flows.

190f. **Comment:** We [Medicine River Canoe Club] feel that the WETP method used in most instances produces far too low a volume of water to satisfy its [DFWP's] intent. As a DFWP employee stated, "It will furnish just enough water to keep the backs of the fish wet." Due to shortages of money and manpower, another employee implied that WETP was a rather cursory method of getting the job done. (This is not a criticism of the DFWP and does not necessarily indicate a lack of concern or commitment on its part, but just the constraints of time and budget under which most state agencies labor.)

Response: The methods DFWP used were summarized in Appendix B of the draft EIS. In Appendix C (in this final EIS), alternate methodologies are described, studies comparing results from alternate methodologies are reviewed, results from one commonly used method are compared to DFWP's results, the validity of DFWP's assumptions are examined, and some of the methods used by DFWP are described further. Readers interested in more detailed discussions of methods should read papers by Trihey and Stalnaker (1985), Loar and Sale (1981), Wesche and Rechard (1980), Lamb (1989), EA Engineering, Science and Technology, Inc. (1986), or DFWP's review of methods related to the WETP method (Leathe and Nelson 1989).

191. **Comment:** Page 22 of the draft EIS says that three different methods were used to determine reservation requests. If the primary need to be served is to reserve flows sufficient to ensure survival of aquatic organisms to maintain fisheries, how do "the lowest average monthly flow" and "all remaining unappropriated water" methods compare to needed flow rates?

Response: DFWP requested streamflows that it felt represented all remaining unappropriated water on four streams in the East Gallatin drainage to dilute present and future pollutants from the Bozeman area, including the Bozeman wastewater treatment plant. Table 3-8 compares flows corresponding to high and low levels of aquatic habitat found using the WETP method to DFWP's requests on these four streams. The WETP method is described briefly in Appendix B of the draft EIS.

Table 3-8. Comparison of flow rates corresponding to high and low levels of aquatic habitat protection to DFWP's requested reservations on four streams in the East Gallatin drainage

		Approximate flow (cfs) corresponding to:	
Stream	Requested instream flow (cfs)	High levels of aquatic habitat protection (high inflection point)	Low levels of aquatic habitat protection (low inflection point)
Sourdough Creek	35.9	11	6
Bridger Creek	36.6	14	unknown
Rocky Creek	51.0	16	6
East Gallatin River	121.3	unknown	unknown

DFWP requested all remaining unappropriated flows on three tributaries to the Madison River to protect flows in the Madison River below Hebgen Dam when releases from the dam are reduced. Each of these tributaries is located below Hebgen Dam. Table 3-9 compares flows corresponding to high and low levels of aquatic habitat protection to DFWP's requests on these three streams.

Table 3-9. Comparison of flow rates corresponding to high and low levels of aquatic habitat protection to DFWP's reservation requests on three streams in the Madison River drainage

		Approximate flow (cfs) corresponding to:	
Stream	Requested instream flow (cfs)	High levels of aquatic habitat protection (high inflection point)	Low levels of aquatic habitat protection (low inflection point)
Beaver Creek	937	22	16
Cabin Creek	585	22	11
West Fork Madison R.	957	42	22

DFWP used a base flow approach on 17 spring creeks where the WETP method would not have worked well. The WETP method depends on development of a stage discharge relationship and on how the wetted perimeter of a stream changes with flow rate. Because flow rates on spring creeks are relatively constant, it is difficult to establish such a relationship based on measurements of stage and discharge.

If existing aquatic habitat is to be protected on spring creeks, a flow rate approximately equal to the existing flow regime should be reserved. For these creeks, DFWP requested the base flow, or the flow rate that typically would occur during the winter. The base flow usually is about the lowest average monthly flow under natural conditions, and although this flow typically occurs during the winter, it may occur during other times of the year on some creeks.

Reduced flows on spring creeks would leave less aquatic habitat available, but this cannot be quantified with existing information.

192. **Comment:** Are the instream flow requests the result of an accurate measuring device, or were they guesstimated? Who sets the criteria for these levels? We [Beaverhead County Farm Bureau] feel the "wetted perimeter method" is inaccurate.

Response: The general purpose of DFWP's reservation requests is to maintain habitat so that existing fish and wildlife populations would be maintained; to maintain a clean, healthful, and desirable environment; and to sustain adequate levels of water quality.

See Appendix C for further information concerning the amount of water needed to maintain fish habitat.

The WETP method used by DFWP, based on measurements made in the field at differing flow rates, shows the amount of riffle width remaining wet as flows change. Table 7 of Appendix C shows the flow rates at which measurements were made in the field. Where the WETP method was used, the instream flow requests were not "guesstimated."

The Board will have to decide whether DFWP's methods are accurate and suitable. Your opinion concerning the WETP method is noted.

193. **Comment:** It appears that DFWP used the upper inflection point to determine needed streamflows for fisheries production. The [Teton County Conservation] District feels that the fisheries estimates should instead be based on the minimum flow needed to provide for stable fisheries—in other

words, the low inflection point. We feel that this level will provide the needed protection yet not preclude other reservations.

Response: The low inflection point flows are listed in Appendix C. Your opinion that the low inflection point flows will provide the needed level of protection to aquatic habitat is noted. If instream reservations were to be granted at flows corresponding to the low inflection point year-round, aquatic habitat in some streams would be reduced substantially from existing conditions. When expressed as a percentage of the estimated average annual flow, the lower and upper inflection points can be compared. The median low inflection point is equal to about 20 percent of the average annual flow, while the median upper inflection point is equivalent to about 43 percent of the average annual flow. This indicates that, in general, the lower inflection point flow is somewhat less than 30 percent of the average annual flow suggested by Annear and Conder (1983) as a good starting point for making instream recommendations, and the upper inflection point flow is somewhat higher.

Instream flow reservations based on the lower inflection point could preclude other reservations in some cases. If reservations for instream flow are granted at the lower inflection point and given priority over reservations for consumptive use, the consumptive use reservations listed in Table 3-10 still would be water-short at times. Note that low inflection points cannot be identified on a number of streams for which reservations are requested.

194. **Comment:** Is the methodology used by DFWP the best one to use in determining the instream flow necessary for maintaining a fishery? Other methodologies may be more appropriate than the one used by DFWP.

Response: The Board will have to determine whether the methods used by DFWP are accurate and suitable for making its decision. Additional information on alternate methods to determine instream flow needs is presented in Appendix C.

195. **Comment:** We [DFWP] disagree with how the term "professional judgment" is used to describe how instream flows are estimated by the wetted perimeter method. Instream flows are determined from the wetted perimeter/discharge relationship derived by the WETP computer program from field observations. Any professional judgment by the biologists would

Table 3-10. Irrigation projects for which reservations are sought that would be water-short in dry years if the Board grants instream reservations based on low inflection points (low levels of aquatic habitat protection)

Drainage	Stream	Project Number	Reductions in Flow (cfs) During August of Dry Years	August Flows in Dry Years (cfs)	Low Inflection Point Flow (cfs)
Jefferson	Jefferson and all tributaries	JV-17 JV-18 JV-25 JV-55 JV-63 JV-80 JV-81 JV-95 JV-201 JV-202 JV-203 JV-204 BR-52 BR-101 GA-102	243	538	550
Gallatin	Gallatin River and tributaries	GA-13 GA-14 GA-24 GA-35 GA-40 GA-41 GA-44 GA-46 GA-79 GA-79 GA-81 GA-92 GA-110 GA-124 GA-130 GA-143 GA-151	19.22	388	500
Missouri River drainage - Three Forks to Holter Dam	Tenmile Creek	LCI-11		4	4
Missouri River drainage - Holter Dam to Great Falls	Dearborn River	LCI-20	1.59	32	50
	Smith River above Eden	CSI-120 CS-71 ME-11 ME-12 ME-20	11.8	83	80
Belt Creek	Belt Creek	CHS-1 CS-42 CS-43 CS-44 CS-159 JB-61 JB-281	3.57	27	35

be from their knowledge of the stream's fisheries, the relative value of each stream, and the need for instream flows to maintain those fisheries.

Response: The language from DFWP's application (DFWP 1989) is reprinted below.

> The final flow recommendation is generally selected from this range of flows by a consensus of the biologists who collected, summarized, and analyzed all relevant field data for the stream of interest. The biologists' analyses of the stream resource form the basis of the flow selection process. Factors considered in the evaluation include: (1) level of recreational use, (2) existing level of environmental degradation, (3) water availability, and (4) size and composition of existing fish populations. Fish population information is a major consideration for all streams. A marginal or poor fishery may only justify a flow recommendation at or near the lower inflection point unless other considerations, such as the presence of "Species of Special Concern" (arctic grayling and westslope cutthroat trout, for example) warrant a higher flow. In general, streams with exceptional resident fish populations, those providing crucial spawning and/or rearing habitats for migratory populations, and those supporting significant populations of "Species of Special Concern" should be considered for flow recommendations that are at or near the upper inflection point. The Missouri basin streams in this application are generally those with the highest resident fishery and/or spawning values and, consequently, for most of these streams upper inflection point flows are requested.
>
> Other streams considered for upper inflection point recommendations are streams that have the capacity to provide an outstanding fishery, but are prevented from reaching their potential because of stream dewatering. Flows at the upper inflection point provide a goal to strive for should the means become available to improve streamflows through such measures as water storage projects or the purchase and/or lease of irrigation rights. Streams that are subjected to other forms of environmental degradation, such as mining pollution, and which have the potential (assuming other habitat factors are suitable) to support significant fisheries if reclaimed, are additional candidates for upper inflection point recommendations. Both of these categories describe some streams in this application.

AMOUNTS

196. **Comment:** DFWP should be allowed no more than 5 cfs for instream flows to maintain water quality and fishery in the Musselshell River.

Response: DFWP applied for an amount of water the agency considered necessary to support aquatic life. The Board will have to decide whether the flow requested by DFWP is appropriate.

197. **Comment:** The instream flow request for the Sun River should be higher than 100 cfs. This river has the potential to be a Blue Ribbon fishery.

Response: The commenter's opinion that the Sun River has the potential to become a Blue Ribbon fishery is noted.

198. **Comment:** On page 97, column 2, first paragraph, the discussion of the occurrence of pallid sturgeon above Fort Peck Lake is very brief. DFWP has additional information that could expand the discussion of the pallid sturgeon, which has been listed as an endangered species under federal law.

Response: Additional information is included in Chapter Two of the final EIS.

GENERAL

199. **Comment:** What would be the effects of the drawdowns on Lake Elwell? This did not seem to be addressed in the EIS.

Response: DNRC examined the expected drawdowns at Lake Elwell and found that if the reservoir were operated using existing guidelines during the period modeled, the lake would be drawn down by roughly 1 foot during August and September of wet years and by less than 0.5 foot the rest of the time under the Consumptive Use Alternative. The resulting environmental effects of the three alternatives are considered minor. However, if storage in Lake Elwell is used to mitigate for proposed diversions from the Marias and Missouri Rivers, reservoir drawdowns would be much greater (see pp. 239-241 of the draft EIS). Because minimum pool elevations could decline as much as 77 feet at times, impacts to recreation could be severe.

200. **Comment:** DFWP has not submitted evidence that the amount of water requested for reservations actually is needed. DFWP has not defined at what level it wishes to sustain fishery and wildlife. Is it to keep a minimum live stream, or is it to enhance fishery and wildlife?

Response: Rather than try to paraphrase the purpose of DFWP's reservation request, its own summary is reprinted below.

> PURPOSE OF THE RESERVATIONS
>
> Section 85-2-102, MCA, and ARM 36.16.102 define beneficial use of water to include "...but not limited to agricultural (including stock water), domestic, *fish and wildlife*, industrial, irrigation, mining, municipal, power, and *recreational* uses;. . ." (Emphasis added)
>
> The purpose of the reservations is to reserve flows for existing and future beneficial uses so as to maintain a minimum flow, level or quality of water by month and throughout each year to attain and serve those beneficial uses as follows:
>
> (1) for the benefit of the public for fish and wildlife uses; and
> (2) for the benefit of the public for recreational uses.
>
> The attainment and service of such uses are to:
>
> (1) provide fish and wildlife habitat sufficient to accommodate a diversity of species comprising this natural resource at levels comparable to existing levels;
> (2) contribute to, and maintain a clean, healthful and desirable environment;
> (3) sustain adequate levels of water quality; and
> (4) honor and support all existing water use rights.
>
> The beneficiaries of the reservations will be the numerous and varied fish and other aquatic species currently inhabiting the streams and waters of the Missouri basin as well as those wildlife species which depend in one form or another on the flows and adjacent riparian areas along those streams. Other beneficiaries are the people of Montana, resident and non-resident fishermen, other stream-based recreationists who visit from other states, and those Montana businesses which depend upon the fisheries resources for their livelihood and economic well-being. Other benefits accrue to those non-fishermen who merely wish to enjoy the streamside setting and the associated animal and bird life provided by flowing waters.
>
> Maintaining flows in stream channels also indirectly benefits those persons who divert water for consumptive uses by protecting them against upstream water users who may have lower water use priority dates than the reservations. At the same time, the reservations honor and support all *existing* water rights.

During the contested case hearing, each applicant will be given the opportunity to present additional evidence to show that its reservations are needed.

201. **Comment:** How much water asked for by DFWP is for actual maintenance of the fishery, and how much is for aesthetic values? We [Montana Water Resources Association] would like that defined.

Response: DFWP's application does not indicate that water is requested for aesthetic purposes. A summary of DFWP's stated purpose and need is described in greater detail in response to comment 200. The amount requested and the reason DFWP believes its request is in the public interest were published on page 22 of the draft EIS.

202. **Comment:** What is the purpose of instream flows? Is it to maintain fisheries in their present condition or to improve them? Is it to maintain big fish or lots of fish?

Response: DFWP, BLM, and DHES have applied to reserve flows for instream purposes, as summarized in Chapter Three of the draft EIS. DHES has applied for instream flows to maintain water quality. DFWP's and BLM's purposes are to maintain, not enhance, the fisheries. These applicants did not indicate whether they intend to maintain big fish or lots of fish.

203. **Comment:** The draft EIS only assumes that good fisheries are now established. There is no treatment as to the impact each water reservation will have upon fish and wildlife habitat. There are many factors that influence the quality of a fishery: water temperature, food supply, adequate spawning beds, diversions, stream velocity, competition of species,

DFWP stocking practices, and fishing pressure, just to mention a few. A more detailed analysis is needed before an overall statement can be made about streamflow and adequate fisheries.

Response: The draft EIS does not assume that "good" fisheries now are established. As Table G-1 (Appendix G of the draft EIS) indicates, fisheries resource value class ratings range from class 1, outstanding, to class 5, limited value fisheries, for streams affected by these reservations. In addition, Tables 6-23, 6-24, and 6-26 in the draft EIS (pp. 206-212) indicate that some of the affected streams do not support populations of gamefish.

As stated in the draft EIS, environmental assessments (EAs) were prepared for each reservation request in order to present a more detailed analysis of individual project impacts. These EAs were available for public review and comment during the same period that the draft EIS was circulated for comment. Using the EAs to document impacts of individual projects allowed the draft EIS to focus instead on the combined effects of the proposed projects and on individual projects where substantial impacts would occur. Except as noted in the draft EIS, reductions in flow due to individual projects, when considered by themselves, would have only minor effects on aquatic habitat.

DNRC concurs that many factors influence fish populations and, on page 202 of the draft EIS, lists some of the same factors mentioned in your comment. DNRC also believes that a more detailed analysis of a few specific projects is needed before an overall statement of impacts can be made. These projects and the specific information that would be needed to assess impacts are described both in the draft EIS and individual EAs.

204. **Comment:** What kind of fish would be protected by DFWP's instream flow application on the Musselshell River?

Response: See page G-14 of the draft EIS.

205. **Comment:** How have the fish survived all these years despite irrigation? DFWP does not explain the need for a reservation when, historically, stretches of streams that have gone dry during drought periods have normal fishery and wildlife when rivers and streamflows return to normal.

Response: It is known that withdrawal of water for irrigation can affect fish populations, and the instream flow reservations are intended to prevent these conditions from getting worse. Where streamflow is adequate and other habitat factors such as water quality, cover, and food production are suitable, fish might survive despite the diversion of irrigation water. Where streams are completely dry year after year due to irrigation, it is doubtful that substantial populations of gamefish would continue to exist. On streams experiencing periodic low flows due to irrigation, fish populations could decline during the dry period with the surviving fish possibly repopulating the affected stream reach.

It is important to note that the long-term effects of repeated low flows on fish populations are unlikely to be the same as infrequent occurrences of short-term low flows. According to Trihey and Stalnaker (1985):

> The ability of fish populations to compensate for a one-in-ten-year low flow event may give the false impression that the fish population will remain viable if this minimum flow (drought) condition were imposed year after year.

206. **Comment:** The assessments of instream flow required to maintain fisheries indicate that there must be a constant amount of water in the streams. Fisheries can be maintained with intermittent flows.

Response: DNRC did not assume that existing fisheries could be maintained only with constant flows. Flows could be reduced for short periods of time to very low rates, and some fish still may survive. It is important to note, however, that the long-term effects of repeated low flows on fish populations are likely to be more detrimental than the effects of infrequent occurrences of short-term low flows (see response to comment 205).

207. **Comment:** More fish die during the winter than during the summer.

Response: In general, winter is a stressful time for trout, and many do die during this period. However, extensive study would be required before the relative importance of one cause of mortality over another could be determined within a given year on a given stream.

208. **Comment:** The information included in Appendix G indicates to the [Teton County Conservation] District that some, if not many, of the requests for instream flows are based on fish populations that have little value from a recreation standpoint. There is also a great deal of doubt in the District's mind about how the charts in Appendix G were developed. There is no indication on how the numbers of

individual varieties were determined and how the value of the fishery was determined. However, we are concerned that these values were determined by DFWP. Since DFWP also is requesting a reservation, this provides for the potential that DFWP would provide information that would be most beneficial to its application.

Response: Appendix G was included to show that not all streams for which reservations are requested have the same value as fisheries. The Board may wish to consider this information in making its decision on requested reservations for instream flow.

The complete methodology is described by Graham (1986). One exception to the methodology should be noted. When a discrepancy was found between the relative abundance of fish in the Rivers Study Reports for streams in the Montana Rivers Information System (MRIS 1989, 1990) and information in DFWP's application, the presence of fish species was noted with a "P" (present) in Table G-1, rather than with the relative abundance as indicated in each source. DNRC feels that this study received sufficient review from state and federal agencies to serve as a comparison of the relative values of streams as fisheries.

209. **Comment:** The Jefferson River was severely affected by the drought of 1990 and has not recovered.

Response: Beginning about 1985, brown trout populations in the Jefferson River have declined possibly due to drought. The brown trout populations, however, could rebound with improved flows. In the Hell's Canyon section of the Jefferson River, there still are about 400 brown trout per mile (Spoon 1991).

WILDLIFE

210. **Comment:** Page 214 of the draft EIS states: "Birds of prey (raptors) could be affected by development of irrigation projects through disturbance during the nesting and brood rearing period (May through August)." Also, "Reductions in streamflow due to increased irrigation could increase waterfowl deaths by predation." As ditch rider for the Vigilante Canal, I [Dorothy Stout] have watched several pairs of nesting raptors and their broods throughout this period and hundreds of ducks and ducklings enjoying the security of the canal. It is my opinion that irrigation aids wildlife.

Response: Irrigation aids some species of wildlife, but it also can displace wildlife not accustomed to farming activities. Raptors not accustomed to humans and machines operating within sight or sound of an active nest could abandon the nest and young. Some raptors develop tolerance of human activities, particularly if activities are predictable and routine.

Irrigation ditches can increase habitat for breeding waterfowl if there is sufficient vegetation adjacent to the ditch to allow secure nesting cover. Activities in fields adjacent to ditches such as mowing hay or plowing could destroy waterfowl nests and young. Reductions in streamflow from irrigation diversion could increase mortality of waterfowl nesting on islands in rivers. Reduction of water depth around nesting islands would render the nest more susceptible to predation by raccoons, foxes, and coyotes.

211. **Comment:** Statements on page s-4 of the "Summary" in the draft EIS in regard to effects of reservations for irrigation on wildlife habitat are wrong. Ducks and raptor populations increase along irrigation canals.

Response: If irrigation canals are filled during the waterfowl breeding season, it is possible that local duck and goose populations could increase once consumptive use reservations are developed. Sixteen of the 219 irrigation projects incorporate new canals into the project design. Table 3-11 lists these projects. Pipelines would be used to transport water on most of the remaining projects, while a few projects would call for cleaning or upgrading existing canals.

Table 3-11. Proposed irrigation projects requiring construction of new canals

Project Number	Total Canal Length (miles)
VAS-1	32.0
JV-55	1.8
JV-201	9.2
JV-203	7.1
CHS-1	1.0
CHS-3	7.1
CHS-5	5.3
CHS-6	15.1
BR-101	3.8
BR-103	2.0
BR-104	18.0
BSS-2	16.9
CSS-200	9.4
FE-161	1.2
FEI-50	3.5

Raptors are especially sensitive to disturbance during the nesting season and may abandon nests and young if human activities such as plowing fields or operating machinery take place within sight and sound of nests. Over time, it is possible that raptors may become habituated to farming or other human activities and show minimal adverse response to routine and predictable disturbances.

212. **Comment:** The draft EIS does not include sufficient documentation of fish and wildlife resources on each of the stream reaches for which the applicants seek instream reservations.

Response: In the draft EIS, pages 86-98 and Appendix G document fisheries resources on the streams for which instream reservations are requested. Wildlife resources are summarized on pages 98-101 and described in greater detail in the environmental assessment prepared for DFWP's water reservation application.

213. **Comment:** The effects of irrigated agriculture on wildlife as stated in the EIS are inaccurate and biased. Admittedly, there is a change in wildlife with the introduction of irrigated agriculture, but the change benefits wildlife. An extended survey of wildlife within and adjacent to irrigated agriculture clearly would show an increase and diversification of wildlife. DFWP has not made this survey. The EIS does not state why a change from native grasses to other types of feed is detrimental to wildlife or that an increase in wildlife because of irrigated agriculture is not desirable. The detail in which irrigated agriculture has an adverse effect on wildlife, as stated in the EIS, clearly shows that this part of the EIS was authored by DFWP.

Response: Irrigated land can increase the numbers and types of some wildlife such as pheasant, hungarian partridge, small mammals, and deer. However, converting land to irrigation decreases other species such as sage grouse, meadowlark, sharp-tailed grouse, prairie dog, burrowing owl, and others dependent on native plant communities for breeding, food, and cover.

The change from native grass to crops is not necessarily harmful to wildlife. As stated in the draft EIS, irrigated land may attract deer, antelope, and elk, often causing landowners to request that DFWP control the animals because of depredation on crops. Control of damage to crops often leads to killing of animals.

The wildlife section in the EIS was not authored by DFWP. It was authored by a private consultant under contract to DNRC.

214. **Comment:** Page 99 of the draft EIS states:

> Winter range is the most important seasonal habitat because it is limited in area and has been eliminated or reduced by competing land uses such as residential subdivisions and agriculture.

Mark Petroni of the U.S. Forest Service in Ennis and Sheridan has repeatedly lectured that without the base land in the Madison valley, the elk herd could not possibly survive, and that if ranchers are sufficiently discouraged by the actions of government agencies, the majority of the ranch land will fall into subdivision, leaving no winter range for approximately two-thirds of the herd.

Response: Winter range is essential to elk in the Madison valley and throughout Montana. Conversion of agricultural land or native vegetation to subdivisions in elk winter range would adversely affect wintering elk.

VEGETATION

WETLANDS

215. **Comment:** Irrigation creates wetlands, which the draft EIS does not address.

Response: Wetlands may be created by seepage from canals or seepage of excess water from irrigated fields. This seepage could cause soils to become saturated. Prediction of the precise number, size, and location of wetlands resulting from proposed irrigation projects is beyond the scope of this analysis.

216. **Comment:** What are the long-term implications of instream water reservations on wetlands created as a result of irrigation, irrigation projects and canals, and other existing water uses?

Response: Water reservations cannot preclude senior water right holders—those with a priority date earlier than July 1, 1985—from using water to the extent of their existing rights. Therefore, wetlands created as a result of irrigation uses prior to July 1, 1985, would not be affected by water reservations.

RIPARIAN

217. **Comment:** We [Medicine River Canoe Club] wonder whether the instream requests are adequate for maintenance of healthy riparian vegetation. These corridors provide such a rich habitat for wildlife that any degradation of them ultimately will cause displacement or loss of many forms of animal life, from insects to birds to mammals.

Response: In order to determine the flows needed to protect riparian vegetation, the relationship between flow rate and water table levels in aquifers adjacent to rivers and streams would have to be determined along with the frequency of flooding necessary to provide freshly exposed alluvium allowing propagation of willows and cottonwoods. Such an analysis is beyond the scope of this EIS. The requested instream flows may or may not be adequate to maintain the riparian community.

218. **Comment:** Stream diversions result in lowered water tables and increased stress on riparian vegetation (Smith et al. 1991). Thus, species that occur in riparian communities and the riparian communities themselves will be more directly affected.

Response: For a discussion of the effect of the proposed reservations on riparian communities, see page 217 of the draft EIS.

219. **Comment:** I [Peter Lesica] feel that your report gives short shrift to the loss of riparian plant communities. These communities are essential for an enormous number of plant and animal species. This storehouse of biological diversity already is under pressure from agricultural development, livestock grazing, and encroachment by exotic weeds. Any loss of riparian communities should be scrutinized carefully and avoided if possible.

Response: Page 102 of the draft EIS states:

> Riparian plant communities have distinctive vegetation and soils and are characterized by the combination of high species diversity, high species density, and high productivity.

It is agreed that riparian communities are under pressure from agricultural development, livestock grazing, and encroachment by exotic weeds. If the Board approves irrigation projects, it could add conditions that would protect riparian communities as projects are developed.

GENERAL

220. **Comment:** Increased water for irrigation is one possible result of water reservations. Thus, any rare plants that occur in valley bottom habitats could be affected. Your list on page 103 includes a few of these species but does not include many others.

Response: Based on habitat characteristics and distribution records, it is possible that additional rare plants such as *Ammania coccinea* (scarlet ammania), *Bacopa rotundifolia* (roundleaf water-hyssep), and *Elymus innovatus* (northern wild-rye) could be affected by irrigation projects; however, it is unlikely that such impacts would occur. According to Lesica and Shelly (1991), none of these plants has been collected in Montana for more than 50 years. Also according to Lesica and Shelly (1991), both *Ammania coccinea* (scarlet ammania) and *Bacopa rotundifolia* (roundleaf water-hyssep) are found on muddy shores and shallow ponds. It is unlikely that such habitats would be converted to irrigated cropland.

Elymus innovatus (northern wild-rye) is known from Cascade and Glacier counties in habitats at elevations of about 4,600 feet. Most proposed irrigation projects in Cascade and Glacier counties are below this elevation.

Thelypodium paniculatum (northwestern thelopody) and *Thelypodium sagittatum* (slender thelopody) probably would not be affected because they are present in wet, boggy meadows over 6,000 feet. It is unlikely that wet, boggy meadows would be converted to irrigated agriculture. Also, no irrigation projects are proposed in Beaverhead County, the location of a known population of *Thelypodium paniculatum.*

221. **Comment:** Following is a list of vascular plants considered rare in Montana that could occur in riparian areas in the upper Missouri River Basin: *Ammania coccinea, Bacopa rotundifolia, Carex crawei, Cyperus acuminatus, Elymus innovatus, Rorippa calycina, Thelypodium paniculatum,* and *Thelypodium sagittatum. Rorippa calycina* is a candidate for listing as threatened or endangered by the U.S. Fish and Wildlife Service; all others are considered sensitive in Montana (Lesica and Shelly 1991).

Response: *Carex crawei* (craw's sedge), *Cyperus acuminatus* (short-pointed flatsedge), and *Rorippa calycina* (persistent-sepal yellowcress) are listed as potentially being affected by the proposed projects (see Table 4-33 in the draft EIS, p. 103). It is unlikely that the other species would be affected (see response to comment 220).

RECREATION

DNRC'S SURVEY

222. **Comment:** Why did the survey address recreation and not include industrial, municipal, and agricultural uses?

Response: The recreation survey was intended only to provide comprehensive basinwide information on use levels, trip expenditures, and the value of instream flows for recreation. The value of water for municipal, agricultural, and hydropower uses was obtained from other sources.

223. **Comment:** The public opinion survey on page 108 of the draft EIS is slanted toward instream flows. To be fair, the survey should also ask, "I enjoy knowing that my friends and family can be fed and clothed, if they want to," and "I enjoy knowing that, as a percentage of income, my friends and family spend less on food than any place else." If popular opinion is to be the guiding force in Montana water law, we need to be honest and close up the government buildings in Helena, because what we have is mob rule. We are supposed to have majority rule with minority rights.

Response: The recreation survey was designed to provide comprehensive basinwide information on use levels, trip expenditures, and the value of instream flows for recreation. The survey also touched on attitudes of Montanans on water quality and irrigation. Also see response to comment 225.

IRRIGATION IMPACTS ON RECREATION

224. **Comment:** The EIS is supposed to determine the impacts of the actions examined. However, the draft EIS (p. 229) states that the long-term effects of applications FEI-50 and FE-41 are unknown. Thus, how or when will the impacts from these applications be determined, given an alternative, or be mitigated?

Response: Summer floating typically ends in late July on the Judith River (Gardner 1991). Project FEI-50 would divert up to 63.5 cfs from the Judith River, while project FE-41 would divert up to 0.9 cfs. Diversions primarily for irrigation project FEI-50 and, to a much lesser extent, project FE-41, might adversely affect late-summer floating. These impacts would occur under the Consumptive Use Alternative. Project FEI-50 is included in the Combination Alternative, but FE-41 is not. Neither of these projects is included in the Instream, Water Quality, or Municipal alternatives. No mitigation is proposed for reductions in flow caused by these projects.

ECONOMICS

225. **Comment:** The economic study to determine the value of instream flows on the basis of fishery is not acceptable. The method used cannot guarantee an accurate and realistic value. In-field, personal interviews would guarantee a more accurate and realistic value. There is no way to determine the degree, if any, of collusion in the responses to the questionnaire that would be of benefit to instream advocates. The method used invites collusion. The economic study does not include individual value and priority or food and fiber versus recreation.

Response: The scope and design of the Missouri River basin recreation survey and economic study produced valid estimates of the values of instream flows for recreation. The method selected for valuation of water-related recreation in the basin—contingent valuation—is widely recognized as an appropriate methodology (U.S. Water Resources Council 1983). Eight thousand Montanans were randomly surveyed. Appropriate survey techniques were used to limit possible bias in responses (Duffield et al. 1990). The sample size and methods used are appropriate to the information needs and are consistent with accepted professional practice. A limited project budget necessitated a mail survey rather than an on-site survey.

GENERAL

226. **Comment:** The draft EIS does not include sufficient information regarding the effect the reservations will have on recreational use by the public on each of the stream reaches for which a reservation is sought.

Response: The environmental assessments prepared for each application address effects of individual projects (or requests) on recreation. Information included in each environmental assessment was specific to the source stream of the reservation. Because this information is lengthy, the draft EIS addressed only additive effects on recreation for drainages and subbasins.

227. **Comment:** To assume that providing just enough water to maintain the fishery protects other recreational opportunities is a fallacy. These minimal flows may not even protect the angling experience itself, to say nothing of other water-related activities. As an example, some canoeists—whose experiences on the Sun River date to 1973—feel that 500 cfs would provide the minimum necessary for

passage of rafts, while DFWP has requested only 100 to 130 cfs. On reading other requests in the draft, we [Medicine River Canoe Club] get the impression that the Sun River request is not an aberration but, in all likelihood, is indicative that DFWP has requested too little flow on most streams to even minimally support water recreation, especially boating.

Response: The draft EIS states that instream flow reservations would help protect existing recreation opportunities on streams but may not fully preserve them if additional water development were to occur. The wetted perimeter inflection points that helped establish DFWP instream flow requests would help maintain fisheries and aquatic habitat but would not necessarily provide flows satisfactory for recreation.

228. **Comment:** During the irrigation season, Prickly Pear Creek is periodically dewatered downstream of East Helena to furnish irrigation water. Two miles downstream from East Helena, the stream receives a relatively constant inflow of treated effluent from the Helena wastewater treatment plant. The recreational fishing value of the stream is very low downstream of this discharge. The recreational values described in the table in the draft EIS must refer to the segment of Prickly Pear Creek upstream of East Helena and not to the lower stream segment.

The combination of summer dewatering for irrigation and the presence of treated wastewater effluent has eliminated recreational fishing in the lower stream segment of Prickly Pear Creek. Streamflows in the draft EIS document refer to a gauging station considerably upstream of the Helena valley, and the summer flows at this station are much higher than flows downstream of East Helena.

As correctly described on page 8 of the draft environmental assessment for the City of Helena concerning the connection between Prickly Pear Creek and the well field, "If a poor hydraulic connection exists, adverse effects on recreational fishing would be negligible." If a good hydraulic connection exists between the City of Helena's well field and Prickly Pear Creek, it is expected there still would be no adverse impacts on recreational fishing because of the previously described streamflow and wastewater discharge conditions in the stream segment most likely to be affected by pumpage (i.e., the lower segment of Prickly Pear Creek).

Response: Recreational values and use information shown for Prickly Pear Creek in Appendix H of the draft EIS are for segments extending from Rabbit Gulch to the Forest Service boundary (Section 15, Township 7 North, Range 3 West), and from the Forest Service boundary to East Helena. Estimated angler days per year from the headwaters to the mouth are approximately 2,600.

Although low flows occur on Prickly Pear Creek below East Helena, recreational fishing has not been eliminated. Irrigation return flows in lower reaches of the creek help support a resident brown trout population and sustain recreational fishing (Lere 1991). The draft environmental assessment points out the potential for adverse effects to this resource from the water reservation for the City of Helena.

229. **Comment:** In reviewing the discussion of angler use beginning on page 111 of the draft EIS under "Headwaters Subbasin," we [DFWP] noticed discrepancies in the angler use numbers used throughout the section.

a. It is not clear whether Maps 4-8, 4-9, 4-10, and 4-11 refer to fishing only or total recreation use, since the title is "recreation," but the legend says "angler days."
b. On Map 4-8, the Boulder basin does not add up if it is fishing pressure.
c. Sectional pressure for rivers is extremely hard to allocate accurately from year to year and may fluctuate wildly. Total angler pressure for any given river is a more accurate number. This applies to the Gallatin, Missouri, Sun, Madison, and Big Hole rivers.
d. Under "The Jefferson/Boulder River Drainage" section, page 114 of the draft EIS, the first paragraph does not make sense. Angler days averaging from 21,125 are too low.

Response:

a. Maps 4-8 through 4-11 estimate both angler and non-angler recreation use on subbasin streams. Numbers indicate average angler days per year between 1982 and 1986. Letters H, M, or L indicate heavy, moderate, or limited non-angler use.
b. Angler use numbers between 1982 and 1986 on the Boulder River do show an average of 2,543 angler days per year as shown in the draft EIS.
c. Total angler use for basin rivers is shown in Table 3-12. This information supplements angler use on river segments presented in the draft EIS.
d. As shown in Table 3-11, angler use numbers on the Jefferson River between 1982 and 1986 show an average of 21,125 angler days per year as shown in the draft EIS.

Table 3-12. Total angler use for basin rivers

River	1982	1983	1984	1985	Average
Gallatin	51,738	56,563	53,623	63,940	56,466
Madison	64,896	82,150	105,377	108,712	90,284
Jefferson	24,172	27,456	13,188	19,685	21,125
Big Hole	51,022	49,485	56,314	47,910	51,183 (53,409)[a]
Ruby	9,174	6,956	2,955	7,975	6,765
Red Rock	4,975	955	1,395	5,181	3,126 (3,325)[a]
Beaverhead	26,607	20,563	18,013	24,239	22,356
Missouri					
Three Forks to Holter Dam	42,679	26,927	33,848	38,950	35,601
Holter Dam to Belt Creek	59,473	63,318	88,424	87,548	74,691
Belt Creek to Fort Peck	6,651	13,559	15,203	16,048	12,865
Dearborn	2,486	1,320	1,637	1,246	1,672
Smith	16,316	12,693	9,652	11,824	12,621
Sun	4,605	10,506	8,249	3,507	6,717
Marias	5,358	5,445	2,730	3,630	4,291 (5,080)[a]
Teton	473	1,892	Unavailable	68	811 (1,022)[a]
Judith	2,002	4,379	3,023	3,199	3,151
Musselshell	9,701	8,722	8,916	8,915	9,063

[a] Numbers in parentheses are those shown in the draft EIS. They are higher than results shown here because years with some river segments showing no reported use were not averaged in.

230. **Comment:** On page 119, under "Sun River Drainage," this discussion could be expanded to include a discussion of the difficulty of floating certain sections of the Sun River during the irrigation season, particularly in low water years.

Response: Water levels in the Sun River can fluctuate dramatically, and summer irrigation diversions make some reaches unfloatable. Water is taken out of the river below Gibson Reservoir and at the Fort Shaw and Rocky Reef diversions as well as other diversions.

HYDROPOWER

231. **Comment:** On page 232 of the draft EIS, the first paragraph under "Irrigation and Municipal Power Use Impacts" states:

> Projects included in the Consumptive Use Alternative would use about 185 GWh [gigawatt-hours] per year. The costs that would be imposed on all other electricity consumers by the full development of all these projects would be $1.8 million per year if the replacement cost were 50 mills/kWh (5 cents/kWh), or $11.1 million if the replacement cost were 100 mills/kWh (10 cents/kWh).

It is unclear that if the $1.8 million and the $11.
million relate directly to the 185 GWh per year, ho
increasing the cost/kWh from 50 mills to 100 mill
causes the cost to increase over 500 percent instea
of just doubling. For instance:

> 185 GWh equals 185,000,000 kWh.
> $.05 x 185,000,000 kWh = $9,250,000 (or $9.
> million).

$1.8 million/$.05 per kWh = 36,000,000 kWh (36 GWh).
$11.1 million/$.10 per kWh = 111,000,000 kWh (111 GWh).

The same question is asked for the remaining two paragraphs of this section.

Response: The cost to other users of the 185 GWh electric power requirements of projects in the Consumptive Use Alternative is due to the difference between the cost of new generation and the average cost rates at which power is sold. DNRC's feasibility analysis assumed that power would be sold at 4 cents (40 mills) per kWh in real terms (adjusted for inflation). If new power costs 5 cents/kWh and irrigators pay 4 cents/kWh, there is a 1 cent/kWh shortfall that must be made up by all electric consumers—185 GWh times $0.01 equals $1.85 million per year. If new power costs 10 cents/kWh and irrigators pay 4 cents/kWh, there is a 6 cent/kWh shortfall—185 GWh times $0.06 equals $11.1 million per year. These estimates may be low in some cases. For instance, projects under the Pick-Sloan program would pay about 11 to 12 mills/kWh (1.1 cents/kWh) under current Pick-Sloan rates. For the proposed Milk River diversion, BUREC assumed it would get Pick-Sloan power at 2.5 mills/kWh. The irrigation subsidy from other power users would be much greater in such cases.

232. **Comment:** The discussion of all of the alternatives includes a review of estimated increased power costs. However, there is no discussion of alternatives to hydropower generation. The [Teton County Conservation] District feels that before an accurate assessment of power costs of the alternatives can be made, there needs to be a discussion of the possibility and costs of other power sources such as conservation and cogeneration.

Response: The existing hydropower system provides extremely low-cost power. Operating costs for hydropower are lower than for almost any other form of generation, and the capital repayment costs for the existing installations have been eroded by inflation since they were built. Replacement of existing hydropower lost to consumptive water uses will be in addition to the search for new power required by utilities to serve growing loads. Low-cost alternatives such as conservation and cogeneration will, of course, be the first choices of utilities. However, the amount of low-cost conservation is finite, while estimates of the amount and cost of available cogeneration opportunities are uncertain. These replacement resources would still cost more than the lost hydropower from existing dams. DNRC did not try to predict the cost of replacement resources; instead, the analysis used the values of 5 cents/kWh and 10 cents/kWh as reasonable estimates.

SOCIOECONOMIC CONCERNS

233. **Comment:** The draft EIS does not adequately address the economic and sociological impacts of specific or overall reservations. No attempt is made within the draft EIS to address the economic impacts each reservation will have. Nor does it address the consequences of granting or denying the requested reservations. Population growth and economic development may be inhibited drastically by water availability.

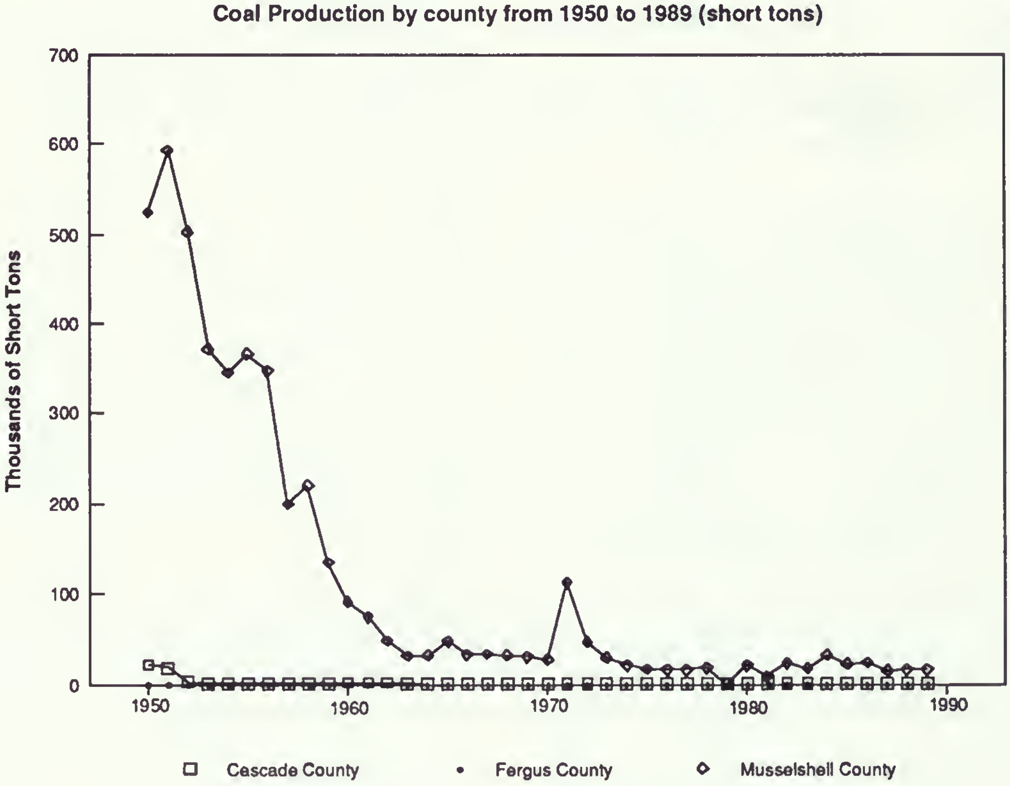
Response: The economic impact that would result from the development of an individual reservation is detailed in the environmental assessment prepared for that application. As stated on the first page of the draft EIS, these environmental assessments are available upon request from DNRC. Economic and sociological impacts also are addressed in Chapters Six and Seven of the draft EIS.

Agriculture's contribution to population growth and economic development is not likely to be affected much by a lack of water for future consumptive use because relative employment and income from agriculture have been declining for four decades. This trend has been largely independent of the supply of irrigation water. Also see response to comment 237.

234. **Comment:** The draft EIS makes no reference to potential water use in coal development, which will require considerable water. Coal development from Roundup (Musselshell drainage) to Lewistown (Judith drainage) to Belt (Belt drainage) has considerable potential in the 40-year time span of the draft EIS. If coal gasification is the route of choice for these deposits, water will undergo true consumptive use. Water would be chemically reacted and gone forever.

Response: Coal production from Cascade, Fergus, and Musselshell counties has seen substantial declines over the past 40 years (Figure 3-3). If coal gasification is chosen for these deposits, coal production may again increase. However, the public entities that are eligible to apply for reservations did not prepare water reservation requests for this possibility. DNRC believes that coal gasification is speculative at this time.

Figure 3-3. The history of coal production in Cascade, Fergus, and Musselshell counties



235a. **Comment:** I [Wayne Turner] object to the upper Missouri River EIS because some of the parts that will affect my ranching business are so vague that it is unclear what will be done. I feel that the way the information and statistics for the water in the creeks were lumped together and averaged is wrong because every one of them is different and has to be treated that way.

235b. **Comment:** I feel that some more data should be gathered about the individual streams so that we could talk about site-specific situations. The draft EIS deals with a broad area, and the northern part of Montana is much different than the southern part. I feel that we should deal with each stream on a case-by-case basis instead of one big area.

Response: Specific information for each stream regarding streamflows, fisheries, recreation, economics, and water quality is provided throughout the draft EIS. More specific information on each stream is presented in the environmental assessment prepared for each project. DNRC did not feel it was reasonable to evaluate impacts specific to each ranching business in the basin.

236. **Comment:** There is no mention of the zer years water flow [drought] and how it will affect an parts thereafter, either sociological or economical c environmental, as one would expect to see in an EIS

Response: The effects of drought years on physica water flows are catalogued in the draft EIS on page 154 through 175; in Appendix C, pages C-1 throug C-65; and in Appendix D, pages D-1 through D-2 As described in these pages, during most drough years water is still flowing in most major rivers though at substantially reduced rates.

The social and economic effects of the propose consumptive uses are discussed on pages 234-23 of the draft EIS. Generally, the social and economi effects of the consumptive use proposals are ver small. The economics of instream flows are discussed on pages 229-230.

The environmental effects of all of the reservations or specific alternate combinations of the reservation proposals, particularly their effects on wate quality, soil, land use, fishery, wildlife, vegetation recreation, power production, agriculture economy and socioeconomic conditions, are discussed o pages 153-244 of the draft EIS.

237. **Comment:** At no place in the document is it mentioned that there might be some form of economic growth other than recreation. We [Wicks Ranch Corporation] gather that there shall be no future mining or industry in the state, much less the newly proposed ethanol plant in Great Falls. The document assumes only that at present good fisheries have been established and the livelihood of all who reside here are directly dependent thereon. This is a misconception.

Response: Future mining or other industrial development in the Missouri River basin is likely. However, only public entities—not private businesses—may apply to reserve water. The EIS addresses reservation requests for municipal, irrigation, and instream uses.

238. **Comment:** It seems that the basic intent of this draft EIS is to assemble water requests from the varied state and federal agencies and propose what will benefit those agencies, with no consideration for existing nongovernmental entities. As one peruses this document, one has trouble locating the social, economic, or environmental impacts that the water reservations will have on those individuals most directly affected.

Response: Chapter Six of the draft EIS describes the impacts of granting the proposed reservations on streamflows, water quality, soils, land use, fish and wildlife, vegetation, cultural resources, recreation, hydropower production, and socioeconomics. The first section of the chapter describes the effects of the reservations on water quantity and distribution and existing water users. Also see response to comment 235. Analyzing the effects on individuals is beyond the scope of this EIS, but aggregate effects on people are addressed.

239. **Comment:** In Judith Basin County, agriculture is the primary industry. We [Judith Basin Conservation District] feel these people are stewards of the land and are initiating and implementing improved management practices of our water resources, such as water quality and water conservation. Agriculture consumptive water use cannot and should not be considered as a secondary faction.

Response: As shown in Figure 3-4, agriculture provides roughly half of Judith Basin County's employment. As measured by personal earnings, the economic situation is substantially different. Agriculture has declined from providing half of all personal income in the early 1970s to about one-tenth of all income at present (see Figure 3-5). Agriculture is likely to continue to be an important part of the Judith Basin economy for the foreseeable future.

The draft EIS did not consider agricultural consumptive use to be secondary. The Board will have to establish the relative priorities among any reservation requests it grants.

Figure 3-4. Employment by sector in Judith Basin county

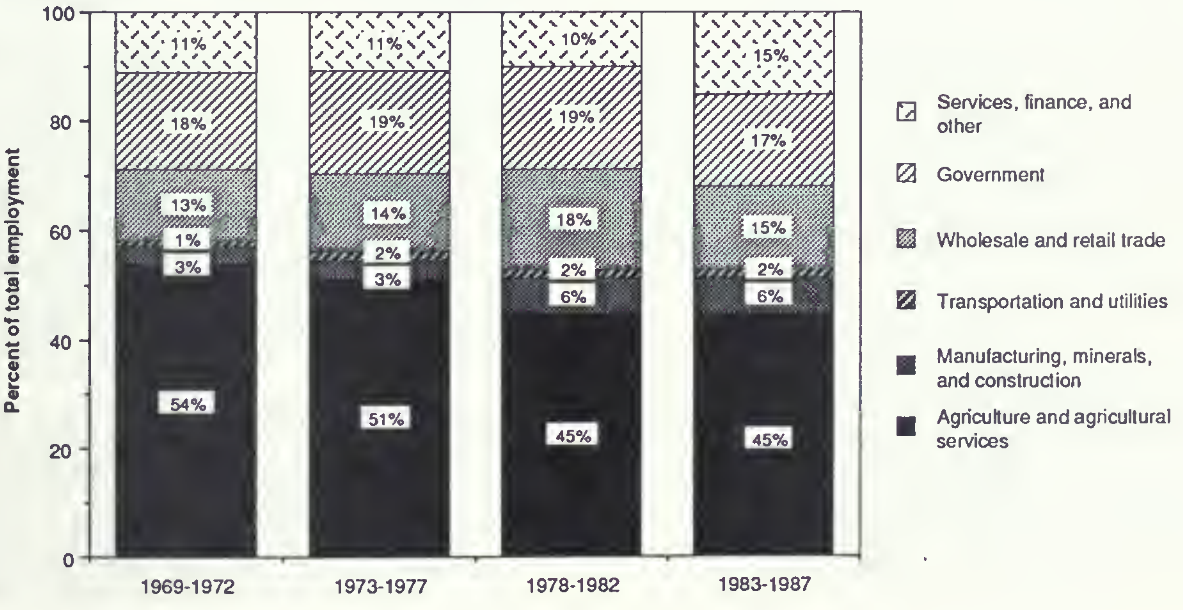
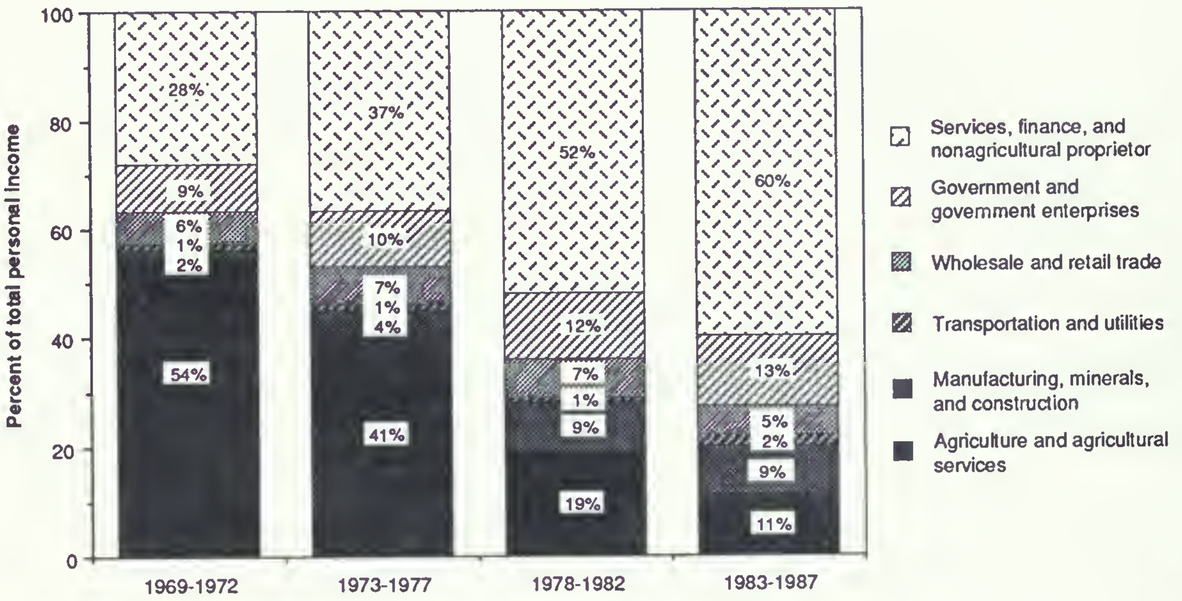


Figure 3-5. Personal income by employment sector in Judith Basin county



Source: U.S. Bureau of Economic Analysis 1989

240. **Comment:** On page 233, "Employment, Income, Agricultural Sales, and Taxation," the draft EIS states:

> Development of the irrigation projects . . . would cause farm-related employment to increase by 30 to 106 employees . . . However, this increase would be offset by the decline in labor required to work, gradually decreasing the amount of irrigated land in the basin.

This statement makes no sense at all.

Response: While some additional jobs would be created by development of the proposed irrigation projects, the *overall* number of persons employed in agriculture is likely to continue to slowly decrease. This decrease in agricultural employment is due largely to increases in farm efficiency; see page 127 of the draft EIS.

POPULATION

241. **Comment:** [Bozeman's projected] 37,000 population figure for the year 2025 does indeed appear somewhat high, although it reflects the thinking of planners and others who developed detailed population projections for the community as part of the 1983 *Bozeman Area Master Plan.* Census data that sets Bozeman's population for 1990 at 22,660 indicate that our [Bozeman City-County Plannir Office] previous projections (which in 1983 projecte a 1990 population of 26,190) were overly optimisti

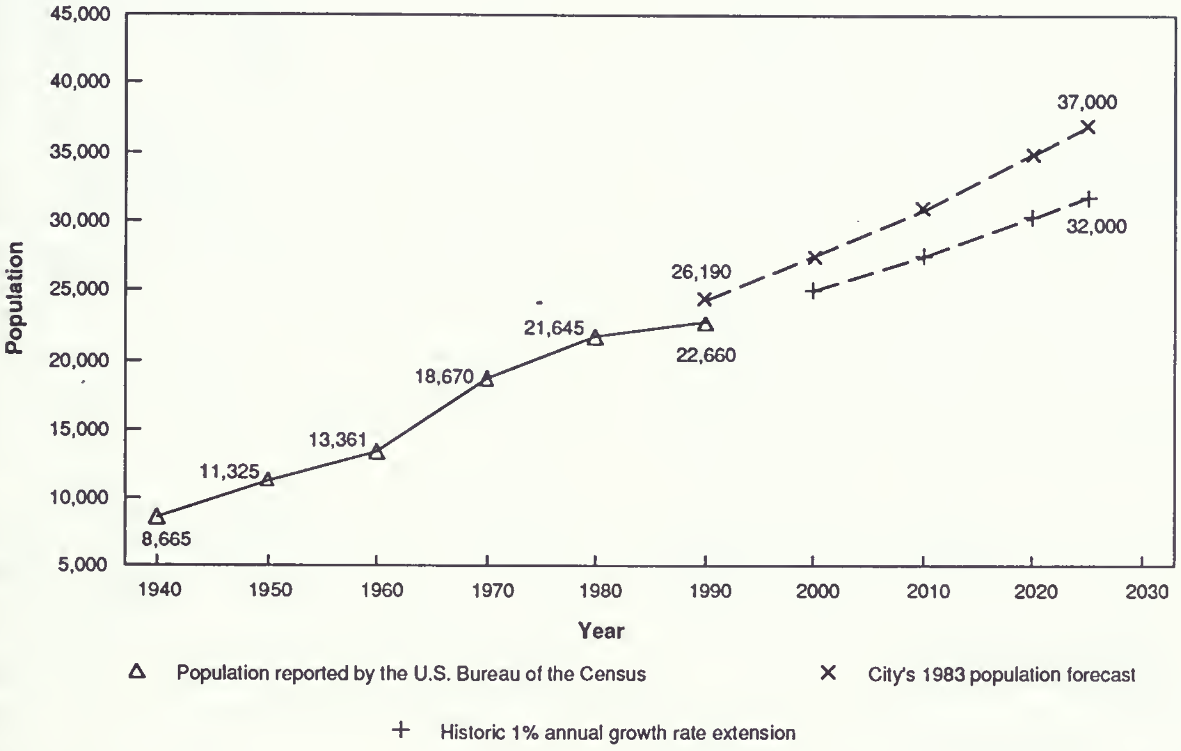
We now believe that a "basic" population growt rate of 1 percent per year should carry us into tl next century. Continuing that trend all the way the year 2025 would lead to a Bozeman populatic estimate of 32,100. However, Bozeman can expe to annex certain areas which would add a significa number of people (2,000) to the population ba described above.

Bozeman is currently experiencing a rapid rate growth and this current trend along with a 1% p year growth rate and expected annexation could ea ily push Bozeman's population up to 37,000 by 202

Planning for growth and providing water for f ture growth are the goals of the water reservatic procedure. To this end, the City of Bozeman feels i request for an additional 6,000 af/yr [8.3 cfs] to ser an expected population of 37,000 in 2025 is a val request based on realistic data and projections.

Response: The City of Bozeman's comments rai two related issues: (1) What is a reasonable estima of city population growth to the year 2025? and (What additional water will be needed for this i creased population? The 1983 *Bozeman Area Mc ter Plan* projected an average annual population i

Figure 3-6. Historical population and population forecasts for Bozeman



crease of 1.2 percent, suggesting a population of 26,190 in the year 1990 and 37,000 in the year 2025 (see Figure 3-6). The city states that recent growth has been just under 1 percent annually and that this rate is expected to continue into the next century. The Bozeman water reservation application states that future population growth is "likely to be slow in comparison to the last decade" (City of Bozeman 1987). DNRC agrees that the revised 1 percent annual growth rate from a 1990 population of 22,660 would project a Bozeman population of approximately 32,000 in the year 2025. The application's estimate of 1.2 percent growth would project a city population of 34,400 in the year 2025.

Much of the city's past population growth and, hence, the historical rate was related to city annexation activity rather than to increased economic activity (City of Bozeman 1987). Unless the city dramatically increases its rate of annexation, the historical 1 percent growth rate already accounts for expected future city annexation activity. Also, unless the City dramatically increases its annexation above the historical rate, an annexation premium of almost 2,000 people probably is redundant.

Bozeman's present per capita water use of 344 gallons per day is greater than most municipalities because of (1) approximately 8 miles of streamside conveyance losses (losing about 1.4 cfs or 1,000 af annually); (2) overflows from the regulating reservoirs; (3) unmanaged diversion gates on Bozeman and Hyalite creeks during the winter; and (4) old leaky water mains (City of Bozeman 1987 and Forbes 1991). Because of these factors, only 57 percent of the city's water diversions actually are used by system customers. The average municipal water use efficiency is 250 gallons per person per day. A city water system of average efficiency would serve the projected city population of 32,000 using 12.4 cfs, or even 37,000 people using 14.3 cfs.

The reservation application did not include water that will be supplied by the current enlargement of Hyalite Reservoir, which is expected to provide an annual addition of 2.9 cfs of water to the city. As summarized in Table 3-13, the new Hyalite Reservoir expansion should provide more than enough water for the expected 32,000 residents using a water system of average efficiency.

Table 3-13. Present and projected water use for the City of Bozeman

	Average day (gpcd)[a]	Peak day (gpcd)[a,b]	Average day (mgd)	Peak day (mgd)	Total year-round water needs (cfs)	Total year-round water needs (af/yr)	City of Bozeman water supply surplus with Hyalite expansion (cfs)	City of Bozeman water supply surplus with Hyalite expansion (af/yr)
(1990) Present Consumption (22,660 people)	198	494	4.5	11.2	6.9	5,019	8.9	6,477
(1990) Present City Diversions (22,660 people)	344	861	7.8	19.5	12.1	8,737	3.8	2,759
(2025) Projected Future Use (32,000 people with efficient water system[c])	250	625	8.0	20.0	12.4	8,976	3.5	2,520
(2025) Application Future Population (37,000 people with efficient water system[c])	250	625	9.3	23.1	14.3	10,379	1.5	1,118

PRESENT CITY OF BOZEMAN RELIABLE FIRM WATER SUPPLIES	(cfs)	(af/yr)
Present City Water Reservoir Sources (from City of Bozeman 1987, and DNRC Water Contract Records 1991)	12.96	9,399
City of Bozeman share of Hyalite Reservoir expansion (1992) (A DNRC dam on Middle Creek)	2.89	2,097
Total City reservoir supply, including Hyalite Reservoir expansion	15.86	11,496

[a] Gallons per capita per day

[b] The City of Bozeman uses a daily peaking factor of 2.5, which is about average for area cities.

[c] Average of 250 gallons daily per person assumes water system efficiencies using improved reservoir regulation, improved diversion controls, and less leaky water mains.

242. **Comment**: DNRC should consider factors other than per capita water use and population growth in the draft EIS when assessing future water needs of municipalities. For Lewistown, the potential exists to export large amounts of Big Spring water, new industries may move in, and city lot sizes are increasing. All of these factors should be taken into consideration.

Response: The applicant requesting a water reservation is responsible for demonstrating that the requested water reservation is needed, using "accurate and suitable" methods (§ 85-2-36(4)(A)(iii), MCA).

The City of Lewistown's water reservation application, developed by Lewistown's consultant in cooperation with the City, was based on "the forecasted population . . . multiplied by the expected per capita water use to estimate the water needs of the community" (City of Lewistown 1988, 12). The application states:

> "Commercial demand would likely grow in proportion to population growth. For this reservation, it is assumed that the commercial uses will expand in direct relationship to population growth. The Comprehensive Plan for Lewistown identifies no large industrial users of water. The reservation does not include a provision for a large industrial demand over and above the commercial use" (City of Lewistown 1988, 29-30).

Because the city did not request specific commercial or industrial water, these other factors were not evaluated.

243. **Comment:** The 1987 application forecast of the city's [Great Falls] population is higher than can be justified when using 1990 census data. The city submitted a revised population forecast and a revised water reservation request in comments on the draft EIS.

Response: The revised Great Falls projected population of 65,605 in the year 2025 appears plausible, including an additional 13 percent for water users at Malmstrom Air Force Base and Black Eagle and those using standpipes. The revised City of Great Falls's municipal peak reservation request of 11.5 cfs, which is based in part on this new projection, appears plausible.

The revised Table 1 and Figure 2 for the Great Falls environmental assessment reflect this update.

244. **Comment:** We [Town of West Yellowstone] now have almost two years of experience with the operation of the [West Yellowstone] water system and find that our water usage is commensurate with the levels we anticipated [for the new metered water system]. Sign-up for use of our system's water was voluntary. However, approximately 85 percent of the residents are currently signed up and using the water, and we anticipate that most of the remaining residents will do the same in the near future as their individual wells and water systems experience maintenance difficulties.

We continue to support our request for a water reservation of 3.53 cfs. We already are seeing changes in our community and subsequent growth that would indicate that this figure is realistic and should be supported in all agency actions.

Response: The Town of West Yellowstone (1987) projected that it would need a future peak use rate of 2.65 cfs for its metered water system (3.52 cfs for an unmetered water system), assuming its forecasted residential and tourism growth occurs. The town has two years of experience with a new metered water system, and its water use is "commensurate" with expectations for a **metered** water system. Actual records of recent system usage would be the most accurate basis for estimating present and future water use rates (Town of West Yellowstone Environmental Assessment 1991).

Most municipalities identified their normal per capita average daily water rate and multiplied this rate by their projected population to estimate their future water needs. In contrast, the Town of West Yellowstone used its "peak" daily per capita use rate and multiplied this by the projected peak one-day population for the year 2025 (of 11,172 residents, which included both residents and tourists) to estimate its water reservation request. Using the "peak" daily use rate rather than the "average" daily use rate increases the town's demands by approximately 37 percent as compared to methods used by other municipalities, suggesting that West Yellowstone's request would be 1.66 cfs using normal water demand estimation methods based on a metered water system. The city also assumes that tourists use the same amount of water as residents.

The Town of West Yellowstone projects a year-round resident population of 2,246 and a summer tourist population of 9,736 for the year 2025 (11,172 total persons). Normal daily residential water use rates (250 gallons per capita per day) would be .9 cfs for the town's projected resident population of 2,246 in the year 2025, or .5 cfs for a town population of 1,270 residents based on historical population growth rates (see Figure 3-7). The remaining water requested by the city would be available for the projected 9,736 tourists and seasonal visitors.

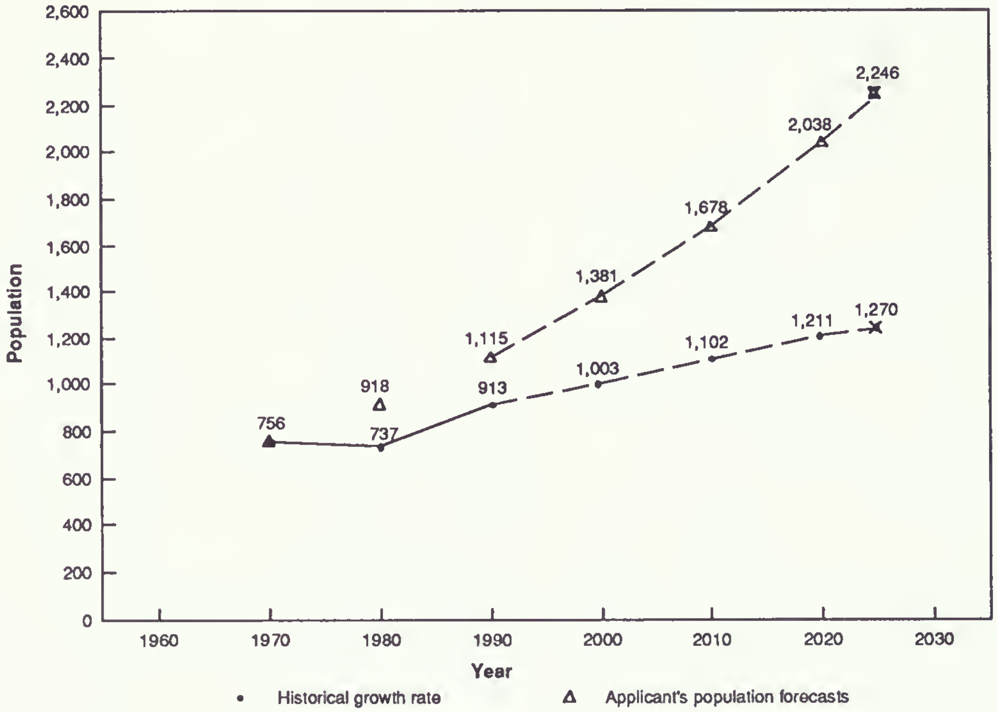
The town presently has a 1986 Montana water use permit for 2.67 cfs from the Whiskey Spring water source. The town's existing permits are sufficient to meet the projected water needs of 2.65 cfs in the year 2025, assuming a metered water system as described in the town's application. A reservation in the amount of 2.67 cfs would provide West Yellowstone with a slightly earlier (July 1, 1985) water use priority date for the same water.

245. **Comment:** They [out-of-staters] want to move here mostly for the beautiful environment, but if you allow these wells (proposed by municipalities) and the reservoir (Bozeman's), the environment is negatively affected. The wells deplete the aquifers, including the Jefferson and Gallatin rivers, and the reservoir floods wildlife habitat. Towns should limit populations based on the resources available, and not further deplete resources.

Response: Most Missouri basin cities (Chester, Choteau, Conrad, Dillon, East Helena, Fairfield, Fort Benton, Great Falls, Power, Three Forks, and Winifred) have populations similar to those of 30 years ago. Belgrade, Bozeman, Helena, and West Yellowstone have experienced substantial population increases, while Cut Bank, Glasgow, Lewistown, and Shelby have seen substantial population decreases over the past 30 years.

The need for municipal water reservations is discussed on page 249 of the draft EIS. Without a water

Figure 3-7. Population trends and projections for West Yellowstone



reservation, municipalities may have to go through a costly process of buying or condemning existing water rights to meet increased future needs.

246. **Comment:** The municipalities requesting water want the water because of the projected population growth of out-of-staters and other Montanans wanting to move in.

Response: Municipalities requesting water reservations are doing so for the purposes listed in Table 3-14.

The overall population of the 26 Missouri River basin counties is expected to increase from 336,000 in 1990 to 385,000 in the year 2020 (see Figure 6-22 of the draft EIS). This annual growth rate of .45 percent is less than the annual natural population survival rate of .70 percent, indicating that population migration out of the basin is expected over the next 30 years. Only four counties (Gallatin, Jefferson, Broadwater, and Lewis and Clark) are projected to grow at annual rates greater than one percent for the next 30 years. The municipalities in these four counties are most likely to experience inmigration of "out-of-staters" and other Montanans.

247. **Comment:** On page S-2 under "Board's Authority," the draft EIS says that " . . . the Board also must ensure that the reservation applicants make progress toward development of the proposed use with reasonable diligence . . . ." Because of the need to make progress, reservation requests for long-term unforeseen water needs on behalf of the whole state are nonexistent. Montana is one of the richest states in natural resources in the United States. Clean air beautiful scenery, and an attractive lifestyle add to the wealth of this state. This EIS does not acknowledge that as promotion of these attributes continues and awareness becomes more widespread, the potential for an explosion in population and/or development demands exists. Nor does it acknowledge what impact water reservations at the volumes requested—particularly by DFWP—would have in the future for Montana to deal with that potential.

Do statewide activities in economic development business recruitment, subdivision development tourism promotion, etc., constitute progress toward development with reasonable diligence that may result in future unpredictable water needs for which no water reservation is being considered?

Although we [Deadman's Basin Water Users Association] strongly disagree with the quantity of the water reservation requested by DFWP, if in fact that reservation is granted, we suggest an absolute condition on the reservation that leaves the flexibility to address the potential for future unforeseen needs.

Table 3-14. Purposes for which municipalities are requesting reservations

Municipality	Purposes
Belgrade	Future municipal use
Bozeman	Future municipal use
Chester	Alternate water right and future municipal use
Choteau	Future municipal and industrial uses and provide alternate water source
Conrad	Future municipal and industrial uses
Cut Bank	Future municipal and industrial uses
Dillon	Municipal use
East Helena	Future municipal and industrial uses
Fairfield	Future municipal and industrial uses
Fort Benton	Future municipal and industrial uses and irrigation of parks and other city grounds
Great Falls	Future municipal and industrial uses and irrigation of parks and other city grounds
Helena	Future municipal and industrial uses
Lewistown	Future municipal and industrial uses
Power-Teton County Water and Sewer District	Alternate water source and future water users
Shelby	Future municipal and industrial uses
Three Forks	Future municipal uses
West Yellowstone	Existing and future municipal uses
Winifred	Municipal and industrial uses and supply better quality water

Response: As described in the response to comment 246, the overall population of the 26 Missouri basin counties is expected to increase by less than one-half percent annually (.45 percent), which is less than the natural survival rate of .70 percent. These long-term population projections (NPA Data Inc. 1990) suggest that all but four of the Missouri basin counties will experience a population out-migration, not a population "explosion." Four counties—Gallatin, Jefferson, Broadwater, and Lewis and Clark—are expected to have population increases greater than 1 percent annually. The prediction is that these four counties will experience population growth rates similar to those of the past 30 years. It's always possible, however, that these or other areas could grow more rapidly than expected due to unforeseeable circumstances. All reservations are reviewed every 10 years by the Board to ensure that the objectives of the reservations are being met.

ECONOMICS

MUNICIPALITIES

248. **Comment:** DNRC should do a cost-benefit analysis for all municipalities that have applied for reservations, including the City of Lewistown, to see whether saving water by renovating existing distribution systems would be more cost-effective than obtaining reservations for additional water.

Response: Upgrading or renovating existing distribution systems may be more cost-effective than obtaining additional water through a reservation. However, this would require engineering and economic analyses that are not reasonably available.

249. **Comment:** How do you put more value on recreation (i.e., boating, fishing, floating, swimming) and hydropower than on cites and towns that depend on the rivers as their only sources of drinking water? Water reservations for municipalities must be given priority.

Response: In Table K-4 of the draft EIS (p. K-10), note that the value of water for municipal use is estimated at $590/af, while the value (from recreation and hydropower) of water left instream—for the Chester location—is estimated at $32.71/af. Even for upstream municipalities such as Bozeman, where instream flow has a much higher value than it does at downstream withdrawal points, municipal use is valued more than seven times as high as instream use.

250. **Comment:** On page 254 of the draft EIS, DNRC calculates the benefits and costs of reservations for

municipal water use. Please explain how the benefits and costs for municipal water use were determined.

Response: The municipal benefits on page 254 are direct net benefits of municipal water uses that are discussed on page 253 of the draft EIS. These estimated direct net benefits of reservations for municipal water use were measured by the total willingness to pay less direct costs. The cost figures listed in Appendix K, Table K-6, are estimates associated with providing requested water to each of the municipalities. Total willingness to pay by consumers in each of the municipalities, however, is not known. Because of time and budget constraints, DNRC used Helena's $2.47 per thousand gallons as a substitute value for total willingness to pay for all municipalities. The municipal costs on page 254 are indirect costs associated with instream flow reductions, which results in losses to recreation and hydropower production, and with increased electrical power loads, which results in higher subsidized power rates.

251. **Comment:** The consumptive value of water for municipalities is shown to be $590 per acre-foot across the board for all municipalities and for any type of water, whether surface water or groundwater (see Table K-4). However, in Table K-6, the cost per thousand gallons of providing this water to each municipality varies considerably among municipalities. We [DFWP] would like to know how the $590 value was derived.

Response: See response to comment 250.

VIRGELLE

252. **Comment:** How can the Virgelle diversion project have a positive cost-benefit ratio?

Response: The proposed project is likely to have direct benefits greater than direct costs. However, a significant financial risk exists that net revenue from the project would be insufficient to repay a 15-year loan covering from half to all of the project's costs. Financing for this project may be difficult to obtain because of the risk. Further, when comparing the value of water used consumptively for the proposed project with the value of water use instream (see p. K-11 of the draft EIS), and therefore comparing both direct and indirect benefits and costs, costs are likely to exceed benefits. It should be noted, however, that because few project details are known after the water reaches the Milk River, a complete analysis of environmental impacts could not be made.

253. **Comment:** Even if cost-benefit figures appear to be favorable for the Virgelle diversion project, they would be suspect because cost overruns are entirely too common on such projects. Such projects have a history of chronically underestimating costs, often an intentional deception to win approval for the project. Then, once the initial investment is made, it turns into a case of throwing good money after bad so the project can be completed.

Response: DNRC did not make an independent cost estimate for the Virgelle project. Instead, the applicant's construction cost estimates were used. If the project costs are understated, true project feasibility would be less favorable than projected.

254. **Comment:** On pages 251-252 of the draft EIS, BUREC's proposed Virgelle diversion project is discussed. This project would provide an adequate water supply to landowners with junior water rights tribes on the Fort Belknap Reservation, BLM stockwater ponds, the Bowdoin National Wildlife Refuge, and the town of Chinook. BUREC performed on-the-ground investigations of the suitability of these lands for sustained irrigation and found that 25,000 acres are arable out of a potential 33,000 acres within the boundaries of the districts and reservation. Is this 8,000-acre difference the same 8,000 acres that DNRC refers to in paragraph 1 on page 252 under "U.S. Bureau of Reclamation"? Or is the 8,000 acres part of the 25,000 acres that BUREC classified as arable? If so, an explanation of why DNRC's land classification differs from BUREC's should be provided. If DNRC refused a water right to the 8,000 acres it (DNRC) classifies as nonirrigable, this action could make the entire Virgelle project infeasible for construction due to a lack of benefits and repaymen capability. This also raises a question as to the appropriateness of acreage determined by DNRC to be nonirrigable in Montana developed under the federal reclamation program. It is not clear from the paragraph how these 8,000 acres are treated in the analysis.

Response: The 8,000 acres referred to on pages 251-252 are from the 33,000 acres of land BUREC has applied for in its reservation application. In its application, BUREC (1989) states:

> This reservation is for 33,000 acres of junior lands in the Milk River Valley. The PFWD [Milk River Water Supply Study: Plan Formulation Working Document], which presents the plan to implement the reservation,

is based on 25,000 acres of junior water right lands. Eight thousand acres were not included in the plan because the lands do not meet the Bureau of Reclamation land class standards. These lands were classified as class 6 [not likely to be irrigable] due to drainage, topography, or soils. If the state or any political subdivision other than the Federal Government is willing to pay full cost to provide reserved water to these 8,000 acres, the canal in the plan would be increased in size to serve the additional acres.

The Board, not DNRC, will decide on granting a reservation for these 8,000 acres. Questions concerning the federal reclamation program are beyond the scope of this EIS.

255. **Comment:** On page 255 of the draft EIS, the second paragraph under "Reasonable Alternatives with Greater Net Benefits" suggests dropping 1,000 acres that are not suitable for irrigated alfalfa from the Virgelle project. Is this 1,000 acres included in the 8,000 acres discussed in comment 255, or is it an additional 1,000 acres? This needs to be clarified.

Response: The 1,000 acres referred to on page 255 are in addition to the 8,000 acres. In the *Milk River Water Supply Study: Plan Formulation Working Document* (DNRC and BUREC Undated), this acreage was classified as unacceptable for irrigated alfalfa production. It could be used to produce bluejoint hay. DNRC's analysis of bluejoint hay production indicates that this part of the Virgelle project is neither economically nor financially feasible.

AGRICULTURAL VALUE

256. **Comment:** The numbers in Table K-4, page K-11, concerning application FE-111 probably are erroneous. The consumptive value in dollars per acre-foot should be at a minimum of $38.00 per acre-foot. Errors of this magnitude negate the validity of the whole document. If this is not an error, the derivation of given statistics needs explanation.

Note: We [Wicks Ranch Corporation] run an additional 80 cows because we do irrigate 80 acres from Big Spring Creek and 15 acres from Wolverine Creek. The cattle graze on this acreage four months out of the year, so the income from the irrigated acres would be a third of the income from the 80 head of cattle. At today's prices, that is $12,000 derived from the 95 acres of irrigated land. Our water right lists our permitted volume at 315 af. That makes the value of an acre-foot of water $38.10. If we raised hay on the irrigated land, the gross income attributed to irrigation would be considerably higher (3 tons times $80.00 times 95 acres divided by 315 af equals $72.38/af).

Response: The consumptive value for FE-111, as for all proposed irrigation reservations, was calculated in the draft EIS by multiplying the annualized net present value for each project by the number of total acres in the proposal and then dividing by the requested water amount. An average 50 percent return flow was assumed, thus doubling the consumptive value. The consumptive value, therefore, is a direct function of the net present value, which was calculated by using the methodology developed by Tubbs et al. (1989).

The consumptive values of irrigation reservations take relevant production and investment costs into consideration and are calculated using net revenues. The $38.10 and $72.38 per-acre-foot values quoted by the commenter are gross revenues, not net revenues.

257. **Comment:** There are a number of irrigation projects that the draft EIS indicates will have bad drainage and likely will have saline seep problems that may require the construction of drainage ditches or the installation of drainage tiles. It is my [Trout Unlimited] understanding that these costs were not factored into the cost-benefit ratio. To give a true picture of the potential cost of the projects, these costs should be estimated and included in the final EIS. These additional costs may well paint a different picture of the feasibility of some of the projects.

Response: DNRC agrees that the potential costs associated with poor drainage and saline seep may significantly affect the feasibility of some projects. Without a complete soil analysis of the proposed projects, however, the magnitude of the drainage problems cannot be established, and the need for drainage systems can be only estimated. Therefore, cost estimates for such systems would not be useful for individual project analysis at this time. The Board may wish to consider such an analysis prior to project development.

258. **Comment:** How is the value of fisheries versus irrigation determined?

Response: The draft EIS (pp. 108-110) briefly describes how the values for recreation, including those for fisheries, were determined, and a detailed description of the recreational valuation method can be found in Duffield et al. (1990). The method used to determine the value of proposed irrigation projects is briefly described on page K-3 of the draft EIS and updated in Chapter Two of this EIS, while a more detailed description can be found in Tubbs et al. (1989).

259. **Comment:** Table K-4 (Appendix K) presents an application number GA-201 for irrigation that shows a consumptive value per acre-foot of $389.49. This project is for irrigating new ground for seed potato production. While this particular crop does have a high return, the investment required for the project is substantial. Without an analysis of the costs and returns associated with this project, we [DFWP] have some questions about the high net return per acre-foot of water used.

Response: DNRC's analysis included all relevant production costs and investment costs associated with developing the potato project (Tubbs et al. 1989). See response to comment 256.

RECREATION

260. **Comment:** The values derived from the recreation questionnaire regarding the amount of money fishermen spend each day are too high.

Response: The estimated per-day angler expenditures for this study that were derived by Duffield et al. (1990) included transportation, lodging, food and beverages, and equipment. These values ranged from $36.15 per day for resident anglers to $188.06 per day for nonresident anglers, resulting in an average $69.21 per-day expenditure for all anglers on Missouri basin waters. This $69.21 per-day expenditure can be compared with estimates in two recent studies: *The 1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (USDI and USDC 1988) and *The Net Economic Value of Fishing in Montana* (Duffield et al. 1987). Per-day expenditures (adjusted to 1989 dollars) for all anglers in all Montana waters were $38.60 for the USFWS study and $48.79 for the Duffield et al. (1987) study. The difference in values may be due to different study years, angler population sampled, and estimated expenditures of Missouri basin waters versus all Montana waters. Another source of the difference between these estimates may be a memory bias. The 1990 study asked respondents to answer questions about their trip most proximate to a certain date. People may have tended to remember longer trips that entailed more planning and greater expense. Because a mail survey was used, it is impossible to determine whether this type of bias affected the responses.

261. **Comment:** The draft EIS mentions values of instream flow for recreation. I [Randall P. Smith] take exception to these values; there are no established water values.

Response: The recreational values used in the draft EIS were estimated using a contingent valuation method (CVM), which is one of the methods recommended by the U.S. Water Resources Council for valuing recreation in federal cost-benefit analysis Under the CVM approach, individuals are directly surveyed on their willingness to pay for the services of a given resource contingent on the existence of a hypothetical market situation. This technique has been applied to a wide range of environmental and resource issues, including air and water quality changes, scenic beauty, wildlife, and instream flows Water is a public good with no market-established value, and CVM is one of the widely accepted and recommended methods of estimating values for water uses.

262. **Comment:** The economic values of recreation in the Missouri River basin draft EIS appear low.

Response: In the draft EIS, the amount of money a person would be willing to spend per day for a recreation trip over and above what he or she actually spent (net economic value) was based on a survey study completed in 1990 (Duffield et al.). The estimated net economic values per day of all combined river activities can be compared to previous estimates of values associated with river recreation Walsh et al. (1989) reviewed 120 studies of outdoor recreation demand completed between 1968 and 1988 for various U.S. sites. Their review reported average values of $30.62 per day (1987 dollars) for cold-water fishing, $48.68 per day for nonmotorized boating, and $20.14 per day for camping, picnicking and swimming. These values are less than the average values of all combined river activities from the 1990 survey study, which are estimated at $52.53 per day for the headwaters subbasin, $60.20 per day for the upper Missouri subbasin, and $65.73 per day for the middle Missouri and Marias/Teton subbasins for river recreation by Montana residents. Mean values of $193.30 for river recreation by nonresident anglers estimated from the current study are well above previously reported means.

263. **Comment:** The draft EIS says that recreation values are lower in the basin downstream of Great Falls. However, an untapped potential exists for more recreation in that part of the basin. This potential needs to be addressed.

Response: The potential exists for more recreation throughout the Missouri River basin, including the lower basin. The degree to which this potential would affect future recreation value is beyond the scope of this study.

264. **Comment:** Your economic feasibility studies do not consider affected instream flows, wildlife habitat, and recreation, but they should—even if difficult to calculate.

Response: The economic and financial feasibility studies analyzed only the direct benefits and costs of individual proposals in order to determine whether the applications were of beneficial use (§ 85-2-16(2)(a), MCA). The direct net benefits from these studies then were combined in the "Public Interest" section (p. 247) of Chapter Seven of the draft EIS. It should be noted that some environmental impacts discussed in Chapter Six of the draft EIS either could not be determined or were assumed to have zero net benefits and, therefore, were not included in the "Public Interest" section.

265. **Comment:** Tourism and recreation-oriented activities would be adversely affected by the Consumptive Use and Combination alternatives. If this is so, how can they constitute a visible and growing segment of basin economy?

Response: Overall recreation and tourism-related services still would constitute a growing segment of the local economy, though the use of some rivers and streams could decline as flows decrease.

266. **Comment:** The economic information for recreation is presented by geographical area and not by individual waters. This tends to hide the economic value for highly valued waters. Also, the instream values shown in Table K-4 are the same for the Gallatin, Jefferson, and Madison rivers. However, the *net economic values* associated with fishing these waters are not the same and, in fact, are quite different, i.e., Madison River - $160 per day, Jefferson River - $79 per day. The draft EIS analysis dilutes the value of instream use on more important waters by presenting the values on a geographical basis and by combining all types of recreation use into one value. Other examples are the recreational values shown in Table 6-40 (p. 229).

Response: The DNRC recreation survey was designed to establish a value for instream flows for each subbasin based on all water-related recreational uses and to complement existing studies such as the one cited (Duffield et al. 1990) that established the net economic value of fishing on certain Montana streams. It was not practical to collect site-specific values on an acre-foot of flow on all of the stream reaches in the Missouri basin with requested reservations.

267. **Comment:** On page 229, Table 6-41 lists the average flow reductions in acre-feet for the three alternatives. Under the Instream Alternative, 0.0 af will be depleted during July and August in the headwaters subbasin. This figure addresses only the impacts of the reservation requests, not the potential depletions caused by new water use permits. In the case of the instream reservations, new permits could deplete flows down to the granted instream reservations. Theoretically, even if DFWP obtains priority over agriculture, flows still could be depleted down to the instream flow requests, or flows could be depleted on streams where DFWP has no reservations, possibly affecting flows in the reservation streams. Consequently, the 0.0 figure (and perhaps the others as well) is misleading and does not truly reflect possible future streamflows. Also in Table 6-41 on page 229 and Table 6-42 on page 230, the July-August flow reduction for the upper Missouri subbasin under the Combination Alternative (20,470.5 af) exceeds the value for the Consumptive Alternative (20,163.1 af). Is this possible?

Response: The discussion of impacts in this EIS focuses on those that would result from the requested reservations. While it is recognized that other factors such as new water use permits could affect instream resources (see "Fisheries," p. 202, and "Recreation," p. 224), this document does not attempt to quantify future streamflow reductions from all new water development, but only those from development of reserved water. The figure in Table 6-41 for flow reductions in the upper Missouri subbasin under the Consumptive Use Alternative (20,163.1 af) is incorrect. It should be 49,608.7 af.

268. **Comment:** The information on Page 109 details the expenditures per day (see Table 4-41), while the information for the net economic value (see Table

4-43) is for all recreational trips, not a per-trip basis or per-day basis. Appendix K provides recreational values on an acre-foot basis but does not provide the necessary information on how the net economic value per trip was converted to net economic value per acre-foot of water.

Response: The methodology needed to derive recreational expenditures per day, net economic value of all recreational trips, and recreational value per acre-foot comes directly from *Instream Flows in the Missouri River Basin: A Recreation Survey and Economic Study* (Duffield et al. 1990).

TAXES AND EMPLOYMENT

269a. **Comment:** At present, our economy is supported heavily by livestock and crops. If this should be changed to recreation, it would be difficult for cafes, motels, outfitters, and gas stations to support taxes for roads, bridges, weed control, airports, district courts, law enforcement, government salaries, schools, and universities. On the other hand, we don't want to lose the tax base from recreational businesses.

269b. **Comment:** On page 127 of the draft EIS, you say that agriculture does not put much into the economy. Without agriculture, Montana would be a national park. I [Margie and Harold Petersen] know this is what some people want.

Response: The discussion of the Montana socioeconomic environment (p. 127) provides an overview of the ongoing changes in Montana's economy throughout the past 40 years. This information from the U.S. Department of Commerce's Bureau of Economic Analysis (1989) shows that Montana has shifted from the agriculture-based economy of 40 years ago to the present economy, where the service sectors comprise the single largest economic sector (as measured by employment or earnings).

The draft EIS predicts no abrupt future economic changes. The relative decline in the contribution of the agriculture sector is independent of the proposed water reservations and likely will continue. The commenters suggest that both agriculture and recreation are important parts of the Missouri basin economy. This is correct, and both will continue to be important in the foreseeable future. The proposed reservations would not have substantial effects on existing tax receipts (see pp. 233-235 of the draft EIS).

270. **Comment:** If water reservations ultimately destroy agriculture in the state, it soon will be apparent how erroneous the statements are in the EIS regarding agriculture income, employment, taxation, and economic impact.

Response: Water reservations would not affect the operations of agricultural water users with priority dates before July 1, 1985.

271. **Comment:** There are many benefits to irrigation, such as increases in state, county, and community revenues. These projects are economically feasible and should increase revenue. This profit then would generate growth in the local communities and state. Brester et al. (1986) estimated that for every $1.00 increase in net revenue, an additional $1.55 may be generated.

Response: DNRC's primary analysis focused on the financial and economic feasibility of each proposed project. External factors such as impacts to local government, indirect and induced employment and income effects, along with the multiplier analysis were included as part of the environmental analysis (see p. 233 of the draft EIS). These factors, however were not considered in the feasibility analysis of each project in order to avoid double-counting indirect costs and benefits in the basinwide analysis.

Irrigation districts, which may have to be formed to facilitate the development of larger projects, pay no property taxes on their project works (§ 85-7-2011, MCA). Further, on-farm sprinkler systems also are exempt from taxation (§ 15-6-206, MCA). It is quite possible that appraisals and tax collections will go down—not up—after irrigation projects are installed because of the way farm land is taxed.

OTHER

272. **Comment:** The alternatives provide an economic analysis of each constituent of the plan, such as agronomic impacts, recreation costs, and power generation costs. However, there does not appear to be a single place that combines this information. We [Teton County Conservation District] feel that the final EIS should include the total economic benefit or cost of each alternative. We feel that when this is done, the Combined Alternative will show the most beneficial economic return for use of the water.

Response: This information was combined in two places in the draft EIS: Table S-1 in the summary and in Chapter Seven. Summary Table S-1 in the draft EIS is in error and has been corrected (see "Changes to Draft EIS"). The "Public Interest" section in Chapter Seven of the draft EIS lists not only the direct net benefits to each constituent but also each alternative's total net benefits. Total net benefits are derived by adding together each constituent's direct net benefits. As illustrated in Table 7-1 (p. 253) of the draft EIS, the Instream Alternative shows a slight advantage in net economic benefits when compared to the Combination Alternative. The alternatives presented are only three of the many ways the Board could allocate water among the reservation applicants. Two additional alternatives also have been examined in Chapter Two of this EIS. Some other combination of reservations could produce greater net benefits than any of the five alternatives examined by DNRC.

273. **Comment:** We [Skyline Sportsmen's Association] oppose the Consumptive Use, Combination, and No Action alternatives for the following reason: The Consumptive Use and Combination alternatives have an unacceptable cost to the taxpayers to build irrigation projects for consumptive users. The cost does not justify the benefits to a select few. The cost of producing power with these alternatives seems to be prohibitive to the rate payers on the power systems.

Response: As pointed out in Chapter Five of the draft EIS, the four alternatives analyzed are purely hypothetical and intended solely for the purpose of illustrating a range of environmental effects and tradeoffs among the proposed reservations. These alternatives do not limit the Board's discretion in approving, denying, or prioritizing the requests for reservations.

Many of the proposed irrigation projects are small and, if built, probably will be financed with private, market-competitive funds. DNRC's analysis, therefore, placed the cost of building these projects solely on those who will benefit. In response to your statement that the cost does not justify the benefits to a few, net public benefits of the Consumptive Use and Combination alternatives relative to the No Action Alternative are positive. This does not necessarily mean that these alternatives maximize net public benefits.

274. **Comment:** The draft EIS does not address the question of instream flow rights versus development rights. What impact would instream flows have on the development of new lands for crop production? The issue of how instream flow would affect Montana's economy and the production of crops in the future is not addressed. A complete economic analysis that analyzes long-term effects is warranted.

Response: If instream flows are granted by the Board, the development of new irrigated crop land might be limited (see Appendix I of the draft EIS). The long-term effects of instream flow reservations on Montana's economy are examined in Chapter Six and in Chapter Seven's "Public Interest" section (p. 247).

275. **Comment:** Basins and subbasins were lumped together for much of the agriculture statistics and were addressed separately for fishery and recreation uses.

Response: Agricultural statistics (pp. 83-86 of the draft EIS) were lumped together to show trends over time for discussion of the affected environment. Specific information on impacts to agricultural land use is indicated on pages 195-201 of the draft EIS. Since impacts to agricultural economics were small, the impacts were lumped together for impact discussions in the draft EIS. Agricultural statistics were broken down for each conservation district and included in the environmental assessments of the water reservation applications for each of the 18 conservation districts. These statistics were not reiterated in the draft EIS.

276. **Comment:** There are not enough statistics on cost-sharing and benefits of multiple-use development.

Response: Section 85-2-316(4)(a), MCA, requires the Board to determine whether the expected benefits of applying the reserved water to beneficial use are reasonably likely to exceed the costs. Because of this, DNRC's analysis focused on overall project feasibility and did not address alternate cost-sharing arrangements.

GENERAL

PROCEDURES

277. **Comment:** We request an extension of the 60-day comment period on the draft EIS because of the complexities of the document and the two weeks it took for some individuals to receive the document in the mail.

Response: The comment period was extended an additional two weeks, ending September 16, 1991.

278. **Comment:** It seems that DNRC always holds its public meetings during the haying or calving seasons.

Response: Because of statutory deadlines for completing the reservation process, DNRC held public meetings shortly after releasing the draft EIS.

279. **Comment:** Who paid for the draft EIS?

Response: The EIS was partly paid for by federal agencies and partly with funds appropriated by the Montana Legislature. Legislative funding was provided to DNRC to cover the portion of the costs attributable to conservation district and municipal applications. DFWP, DHES, BUREC, and BLM used their own appropriated funds to reimburse DNRC for their shares of the EIS's cost. This procedure is consistent with the water reservations statute (§ 85-2-316 MCA), which requires the applicants to provide a reasonable proportion of DNRC's costs of preparing an EIS.

280. **Comment:** DNRC could have used a better method of informing the public of the meetings.

Response: The public hearings on the draft EIS were held August 5-8, 1991, in locations throughout the Missouri River basin. Notice of the public hearings was published in 11 regional and local newspapers. Legal notice was published concurrently three times in the *Billings Gazette*, *Bozeman Daily Chronicle*, *Butte Montana Standard*, *Great Falls Tribune*, *Havre Daily News*, *Helena Independent Record*, *Dillon Tribune Examiner*, *Glasgow Courier*, *Lewistown News Argus*, *Roundup Record Tribune*, and *Meagher County News*. News releases announcing the availability of the draft EIS and the public hearing schedule were sent to all newspapers in the basin above Fort Peck Dam. The draft EIS also included the public hearing schedule.

281. **Comment:** The Skyline Sportsmen [Association] believes there is a serious conflict of interest within the Board, as several members are actual water users on the Missouri River basin. How can we, the sportsmen, get a fair and impartial view from people on the Board who have a financial interest in the water in the basin? The Board of Natural Resources and Conservation appears to overly represent agricultural interests.

Response: Public officers have public trust responsibilities (§ 2-2-103, MCA). A member of a quasi-judicial board may perform an official act notwithstanding economic benefits to a business or othe undertaking in which he or she has a substantia financial interest. However, this participation mus be necessary to the administration of the statute and the board member must voluntarily disclose th nature of his or her private interest that creates th conflict (§§ 2-2-121(3) and 131).

282. **Comment:** The draft EIS fails to adequatel correlate the relationship between the proposed reservations and necessary minimum streamflow level for the specific stream reaches included in the reservation.

Response: See response to Appendix C for an additional discussion of methods to determine instrea flow needs. Additional documentation of impacts fo proposed consumptive use reservations can be foun in environmental assessments specific to each reservation application. In some instances described i the environmental assessments and draft EIS, additional investigation would be necessary to determin impacts from specific projects.

283. **Comment:** We [Margie and Harold Peterse received your answer telling us that it would cos $14.32 (the printing and mailing cost of the draft EI is $12.32 per copy) to mail each EIS on the Missou River basin reservations. That book could be trimme down to much less, and it is ridiculous to waste th taxpayers' money this way. There are so many u truths in this book that some people more respo sible should have written it.

Response: Your comments are noted. DNRC ha responded to specific concerns of these commente elsewhere in this document.

MONTANA ENVIRONMENTAL POLICY ACT

284. **Comment:** On page 1, under "EIS Process the draft EIS states:

> This EIS addresses all pending water reservations requested in the basin above Fort Peck Dam and describes in general terms the reservation requests and the parties and resources that would be affected if the requests are granted.

Our [BUREC] review of the subject document inc cates that it analyzes the associated impacts in ge eral terms because specific details of each propos development were not available. Thus, the subje document serves primarily as a programmatic doc ment, meaning that additional Montana Environmental Policy Act (MEPA) compliance would be required prior to site-specific development. Thus, we are somewhat puzzled by the statement on page 153, which states:

> To comply with MEPA, additional environmental review may be required before large projects can be developed and, in some cases, this may involve the preparation of a project-specific EIS.

We offer the observation that because site-specific details were not analyzed in the draft EIS for any of the proposed projects, additional MEPA compliance will need to be initiated for each project at some future time. We suggest that a commitment to perform such environmental analyses on each be made and included in the section titled "Measures That Could Be Adopted to Reduce Adverse Effects" on page 237.

Response: The Montana Environmental Policy Act (MEPA) requires that an EIS be prepared for major state actions that significantly affect the quality of the human environment (§ 75-1-201(b)(iii), MCA). A programmatic review is done when a series of agency-initiated actions, programs, or policies—which in part or in total may constitute a major state action—significantly affect the human environment. Although the draft EIS is programmatic in nature, site-specific impacts from individual projects were included to the extent possible with current information. Individual environmental assessments also were prepared for each reservation application, and they include more site analyses. For many projects—especially large projects—detailed design information was not completed; thus, site-specific impacts could not be assessed.

Before any projects can be developed, an environmental assessment may be required if state actions are involved or if the Board orders the review. A project-specific EIS analysis may be required if the project—either individually or cumulatively with other development—significantly affects the human environment and if information regarding its impact is not adequately addressed in the draft EIS. For the larger projects, however, it is anticipated that a project-specific environmental analysis will need to address site-specific impacts prior to development.

285. **Comment:** The concept that Montana water reservations would protect Montana water from use and development by downstream states is an uncertain legal concept and not an established doctrine in other western states. The original concept for the reservation process was to protect Montana water for future irrigation development. The EIS does not reflect or even mention this concept.

The requests for reservations for instream flows are contrary to the original purpose of the reservation concept and are providing the downstream states the water the reservation concept was to protect.

Response: The concept that Montana water reservations would protect Montana water from downstream threats was strongly supported by the late Frank Trelease, considered a leading authority on western water law. Trelease wrote the legal section in a report titled *A Water Protection Strategy: Missouri River Basin* (1982) for the Montana Legislature. In this report, he argued that the best way to protect Montana's share of Missouri River water is to use the water and to adjudicate existing rights. The second best way is with water reservations for consumptive use because they identify purposes and places of use and show that projects are economically feasible and in the public interest. The water reservation statute also requires reservants to show diligence in putting reservations to use. A number of other states—New Mexico, for example—have adopted a reservation process to protect water for future use.

The protection of instream flows was part of the original concept of water reservations as enacted by the Montana Legislature.

286. **Comment:** It is obvious that representatives from irrigated agriculture and the general public had no opportunity to participate in the preparation of the EIS. Only BLM, DFWP, and DHES were allowed input into the draft EIS. Municipalities, individuals, and agriculture were excluded.

Response: The general public and representatives of all groups had several opportunities to participate in preparation of the EIS. Public meetings were held during July 1989 in Bozeman, Dillon, Ennis, Fort Benton, Glasgow, Great Falls, Helena, Lewistown, Roundup, and Whitehall to help determine issues that should be examined in the draft EIS. The draft EIS was distributed to the public in July 1991 to give people an opportunity to review and comment on it. DNRC held 10 public meetings and hearings throughout the basin during August 1991 to gather written and oral comments on the draft EIS and accepted written comments until September 16. The final EIS includes DNRC's responses to public comments on the draft.

287. **Comment:** Under the current schedule, the Board will have to make decisions without knowing the availability of water.

Response: Information regarding the physical availability of water for reservations is provided in the draft EIS and the reservation applications. The contested case hearing may provide the Board with additional information to determine whether reservations will affect existing water rights.

288. **Comment:** The size of the draft EIS and water reservation requests is too big. The whole process should be broken down into subbasins, including the EIS process, the reservation requests, and the contested case hearings. How will changes in one basin affect other basins?

Response: DNRC implemented the Missouri basin water reservation proceeding as directed by the legislature. The legislature requested the proceeding be split into two parts, above and below Fort Peck Dam. The EIS addresses those applications to reserve water above Fort Peck Dam.

Because the basin above Fort Peck Dam is so large, the draft EIS used a subbasin approach to examine effects of reservations on the existing environment. Also examined in the draft EIS is how reservations in one subbasin would affect the environment in others.

Separate contested case hearings will not be held for each subbasin. However, the hearings examiner will hold public hearings in communities around the basin where objectors can present testimony specific to their areas.

289. **Comment:** Judith Basin Conservation District objects to the draft EIS insofar as it states or implies that the Judith Basin Conservation District's application for reservation of water does not meet the criteria contained in § 85-2-311(1), MCA, for the granting of applications for permits to appropriate waters.

Response: Section 85-2-311, MCA, includes the criteria for issuance of a water use permit. The Judith Basin Conservation District has applied for a water reservation as governed by § 85-2-316, MCA. The Board will decide whether a reservation application meets the criteria outlined in this statute. Nowhere in the draft EIS is it stated that the Judith Basin Conservation District's water reservation application does or does not meet the reservation criteria.

290. **Comment:** Page S-1 of the draft EIS states:

> The legislature felt that implementation of a water reservation procedure would encourage more coordinated development of the water resources in the basin and would help form a strong and unified basis for protecting Montana's share of the Missouri River water from downstream states.

This water reservation process is a step toward the first stated legislative intent; however, if this process leads to a decision allowing instream flow reservations anywhere near those requested by DFWP, the second stated intent will be unattainable because the sheer volumes requested by DFWP will in fact guarantee substantial flows to downstream states These volumes will additionally be restricted to a single ordained use while in the state of Montana.

Response: See reponse to comment 11.

291. **Comment:** Page S-7 of the draft EIS states:

> On each stream or stream reach, the number of requests that will give the greatest net benefit is based, in part, on the amount of water available. However, water availability may not be definitely known before the Board acts on the reservation requests.

It should be noted and analyzed in the EIS proces what effect each alternative would have on (a) exist ing, unresolved streamflow loss studies, (b) request for moratoriums on issuing permits, and (c) indi vidual water district policies about selling share and share availability. Such analyses may partiall resolve the often-stated, "Water availability may no be definitely known before the Board acts on th reservation requests."

Response: These are legal issues that cannot b addressed in the EIS. They likely will be raised an addressed in more detail during the contested cas hearing.

292. **Comment:** There is no way any individual ca check or digest the computer models and the volum nous studies, statistics, and materials included i the draft EIS within the time frame scheduled, o perhaps at all, without a staff and budget equal t DNRC's.

Response: DNRC was directed by statute to prepar an EIS on the upper Missouri River water reservatio applications (§§ 85-2-316(3) and 75-1-201(1), MCA). The scope of the proposed actions required that many studies be done to analyze the potential impacts. The standard comment period for an EIS is 30 days. DNRC originally allowed 60 days for comments on the draft EIS and later extended this deadline an additional two weeks. ARM 36.2.532.

293. **Comment:** On page 2, under the "Contested Case Hearing" section, the draft EIS states:

> After the final EIS is distributed to the public, DNRC . . . accepts written objections. If valid objections are received, the Board appoints a hearings examiner, and a formal contested case hearing is held.

However, the Notice of Applications, postmarked July 30, 1991, states:

> Formal objections to the issuance of a reservation under the application, with reasons therefore, must be filed on an Objection to Application form (Form 611) with the Department of Natural Resources and Conservation . . . on or before Friday, August 30, 1991.

It is our [U.S. Forest Service] understanding that the correct due date for objections was the August 30 date. Thus, erroneous direction in the draft provides for confusion and could lead people with valid objections to miss the objection period. We suggest reopening the objection period, noting the conflicting direction and explaining the differing timetable, to allow the public to object in a timely fashion.

Response: The deadline set by the legislature for the Board to act on these water reservation applications is July 1, 1992. DNRC felt it was necessary to notify existing water right holders about the water reservation applications before distribution of the final EIS in order to allow time for the contested case hearing. The statement in the draft EIS saying that the final EIS would be distributed before noticing for the contested case hearing was in error.

Notification of the deadline for submitting objections was sent to 11,000 water right holders and published in newspapers throughout the basin. DNRC does not feel that the error in the draft caused interested parties to miss an opportunity to participate in the contested case hearing.

ALTERNATIVES

294. **Comment:** The alternatives seem to be slanted toward instream flows requested by DFWP and BLM.

Response: DNRC developed the alternatives to bracket the range of possible actions the Board could take on the pending water reservation applications. In all but the No Action Alternative, municipal reservations were given first priority. Second priority was given to irrigation projects in the Consumptive Use Alternative, with instream requests given third priority. In the Combination Alternative, second priority generally was given to irrigation projects considered to be at least marginally feasible, with instream requests given third priority. Only in the Instream Alternative were instream flow requests given priority over all requests for irrigation. The No Action Alternative was defined as no action by the Board in granting reservations. Two new alternatives have been developed by DNRC (see Chapter Two).

295. **Comment:** There does not seem to be any stated basis in the draft EIS for classification of irrigation uses in order of priority behind municipal or other uses.

Response: Under the Consumptive Use, Instream, and Combination alternatives presented in the draft EIS, municipal reservations would be given priority over reservations for irrigation and instream flows. The reasons for giving municipal reservations first priority are stated on page 133. Under the Consumptive Use Alternative, irrigation projects are given priority over requests for instream flows. Under the Instream Alternative, instream requests are given priority over irrigation projects. Irrigation projects that are at least marginally feasible generally are given priority over instream requests under the Combination Alternative.

DNRC developed these alternatives to illustrate the effects of different water use emphasis, encompassing a reasonable range of actions that could be taken by the Board. These alternatives do not limit the Board's discretion in approving, modifying, denying, or giving priority to one reservation request over another.

296. **Comment:** DNRC should not have considered the Consumptive Use Alternative, as it is not a viable option. The best option is the Instream Alternative.

Chapter Five discusses various alternatives for granting water reservations. Under the Consumptive Use Alternative, all reservations, whether municipal or irrigation, would be granted whether they were economically viable projects or not. It is disturbing that such projects would be considered where the benefit-cost ratio is less than one. Under the Instream and Combination alternatives, irrigation projects are scrutinized as to their economic viability. It is difficult to understand why economic viability is not also a requirement in the Consumptive Use Alternative.

Response: DNRC developed the alternatives to bracket the range of possible actions the Board could take on the pending water reservation applications. Because it is in the Board's power to grant all applications for consumptive use, DNRC felt it was appropriate to develop this type of a scenario—the Consumptive Use Alternative—and assess its potential impacts. Your comment regarding the Instream Alternative is noted.

297. **Comment:** Why are irrigation and municipal reservations included in the Instream Flow Alternative?

Response: In the draft EIS, DNRC developed three hypothetical alternatives that were within the probable range of action the Board might take. An instream alternative with no consumptive uses is considered in Chapter Two of this document.

298. **Comment:** We [Skyline Sportmen's Association] are opposed to the Consumptive Use, Combination, and No Action alternatives for the following reasons:

a. These alternatives do not address the resource values of recreational use, fish, wildlife, and water quality. These values now are non-existent as the rivers in the basin are consistently dewatered to the point of fish kills; not water for water quality, and wading the puddles for recreation.
b. The Consumptive Use Alternative is single use instead of the multiple use mandated by the Montana Constitution.

Response:

a. The resource values of recreational use, fish, wildlife, and water quality do exist, and impacts on these resources are addressed for all of the alternatives in the draft EIS. Further, instream dollar values, including those for recreation, were calculated and used in the economic impacts analysis and discussion of Board decision criteria.
b. The Consumptive Use Alternative is not a single-use alternative. It includes municipal, irrigation, and instream flow requests.

299. **Comment:** The Skyline Sportsmen [Association] supports another alternative to be considered that would combine the attributes of the municipal and instream flow alternatives. These alternatives are mutually compatible and still provide jobs and benefits to most of the public. The positive effects to the taxpayers, recreating public, fish, wildlife, and water quality are overwhelming. The combination of these alternatives would not adversely affect the current water users. We also endorse the comments of Stan Bradshaw of Trout Unlimited.

Response: No municipal alternative was presented in the draft EIS. See Chapter Two for a description of a new municipal alternative and impacts associated with it.

300. **Comment:** We [American Fisheries Society Montana Chapter] feel there is a need for an environmental quality or water quality alternative. We com to this conclusion for several reasons:

a. The Instream Alternative includes several irrigation projects that have the potential to caus nutrient and pesticide contamination (see Tabl 6-9, p. 184).
b. The Instream Alternative includes irrigatio projects that may damage aquatic life by increasing water temperatures and decreasing dissolve oxygen (see Table 6-10, p. 185).
c. Other projects that lead to water quality degradation such as VAS-1, JBS-3, and FE-141 ar included in the Instream Alternative. In the cas of VAS-1, this includes increasing the concentrations of nutrients, salts, and possibly arsenic i the Milk River.
d. The economic benefits of the three alternativ increase as consumptive reservations are r duced or given lower priority and instream rese vations are increased or given higher priorit This relationship should be explored further wi the development of an environmental or wat quality alternative to determine whether ec nomic benefits continue to increase.

Response: See Chapter Two of this final EIS for description of the suggested Water Quality Altern tive.

301. **Comment:** The draft EIS makes no analysis alternatives to specific reservation requests. Sin the Board must judge each individual water reserv tion request, the environmental impact of each r quest must be made before a decision can be reache

Alternatives to the proposed reservations and their consequences also must be ascertained.

Response: Four alternatives were identified and analyzed in the draft EIS. A description of the alternatives is presented in Chapter Five, and Chapter Six discusses impacts of the alternatives. Potential impacts of each reservation project were analyzed and are included in the environmental assessment of each reservation application. Environmental assessments are available from DNRC upon request.

302. **Comment:** Aspects of the Instream Alternative are troubling because our [Medicine River Canoe Club] interpretation is that it would still allow some consumptive uses.

Response: The Instream Alternative does include consumptive use projects (see Table 5-1 of the draft EIS, p. 135).

303. **Comment:** Who put together the alternatives? It appears that DNRC included only DFWP, DHES, MPC, and BLM.

Response: DNRC put together the alternatives, which include reservation requests by municipalities, conservation districts, DFWP, DHES, BLM, and BUREC. MPC has not applied for and cannot be granted a water reservation and, therefore, is not included in the alternatives. For a detailed discussion of the alternatives, see page 133 of the draft EIS.

304. **Comment**: We [Skyline Sportsmen's Association] are opposed to the Consumptive Use, Combination, and No Action alternatives for the following reason: The alternatives would have a negative effect on the recreational revenue to the state, which is grossly undervalued within the draft EIS. The money being spent on recreation within the state makes recreation the second largest industry within the state, and it is still growing. Approval of any of these alternatives would only subsidize the agriculture users to a greater extent with taxpayer money.

Response: The estimated annual value of lost recreation due to lower flows under the Consumptive Use, Instream, and Combination alternatives is based on the net willingness to pay for an acre-foot of flow in rivers and streams and average flow reductions from the different alternatives (see Tables 6-40, 6-41, and 6-42 in the draft EIS, pp. 229-230), not on recreational revenue to the state.

Recreation and tourism-related services for all facets of recreation in Montana still would constitute a growing segment of the local economy under these alternatives.

Wealth transfers or subsidies to the agricultural sector may contribute net benefits to the public. Your opinion regarding the No Action Alternative is noted.

305. **Comment:** On page 181, first column, under "Impacts to Other Reservants," last sentence regarding priority of proposed reservations, this conclusion applies only to those 50 or so stream reaches where irrigation and instream reservation requests conflict. For the 231 stream reaches where there are no consumptive reservation requests, granting instream a higher priority over irrigation will have no influence on water availability for the other requested irrigation projects.

Response: Under the Instream Alternative, proposed consumptive use reservations would be junior to reservations for instream flows. Streamflows on the lower Missouri River sometimes drop below those requested by DFWP and DHES. Because depletions anywhere in the basin could affect flows downstream, projects for irrigation in the headwaters could not divert water when flows in the lower Missouri drop below the instream requests under this alternative.

ROLE OF THE APPLICANTS

306. **Comment:** DFWP said that granting instream reservations would protect existing water users and, therefore, would be in the public interest. Please explain how, where, and why?

Response: In its Missouri River reservation application, DFWP states: "Existing agricultural water right holders would benefit from the DFWP reservation because of increased legal and physical assurances about future delivery and supply of water for their crops and livestock." For those streams that are overappropriated, establishing a minimum instream right may alleviate the need for existing water right holders to continually object to new appropriations that would adversely affect their existing rights.

307. **Comment:** Did conservation districts apply for instream flows? If not, why?

Response: Conservation districts did not apply for instream flow reservations. While they could have done so, they chose not to.

308. **Comment:** The 18 conservation districts that applied for water did not even consider nonconsumptive uses, just more irrigation. Where does the conservation come in?

Response: The majority of conservation district reservation requests are for irrigation. Table 6-7 in the draft EIS lists three storage projects proposed by the conservation districts that are for purposes other than irrigation.

309. **Comment:** The draft EIS does not adequately address municipal irrigation needs. The basis for municipal water consumption is based upon population growth. For most older communities, lot sizes are rather small. The trend today is toward larger lots, thus requiring considerably more irrigation. Family water consumption also has increased due to new appliances (washers, dishwashers, ice machines, etc.) over the past 40 years.

Response: As outlined in the response to comment 242, the reservation applicant is responsible for demonstrating that the reservation is needed. All of the municipal applicants used population-based methods to project their future water system needs. None of the municipal applications presented any information concerning the effects of increasing lot sizes, so lot size effects have not been examined. In regard to appliance use effects, one city states that "although more people will purchase water-using devices such as dishwashers and water softeners, the city does not expect this change to increase use significantly" (City of Lewistown 1988).

310a. **Comment:** Much of the information used in your EIS came from DFWP. Since DFWP is a party to the reservations being claimed, I [Kalsta Ranch Co.] question the legality of using said information. At the very least, it has a chance to be biased and therefore should not be used.

310b. **Comment:** I [Randall P. Smith] feel that the very agency requesting reservations (DFWP) had a lot to do with writing the EIS, and this is a direct conflict of interest.

Response: Several types of information included in the draft EIS were obtained from DFWP. Each is described below.

a) Paraphrasing of DFWP's statements concerning the purpose and need for the reservation, the amount necessary, and that the reservation is in the public interest.

In Chapter Three, DNRC summarized state ments from each application pertaining to pur pose, need, amount, and public interest. Thes should be viewed as summaries of opinions o the applicants.

b) Listings of streams with low flow problem area (see Tables 4-2, 4-4, 4-6, and 4-8).

Information included in these tables came from at least two of the following sources:
- Information provided by DFWP (1985-1991)
- Information obtained from DHES (1984, 1986
- Information gathered from DNRC's water resources regional offices (DNRC 1985-1991

Because the information corresponded with information from at least one other source, reasonably unbiased result was expected.

c) Types and numbers of fish present in a stream

This information was provided in the draft EIS to give an indication of the relative importance o a stream in providing an opportunity to catc fish. The information shows that some stream have different types of fish and some stream support many more gamefish than others. Th information was obtained from the DFWP appli cation and the Montana Rivers database. DFW is not thought to be biased in reporting the rela tive number of fish in a stream.

d) Fisheries value class rating.

This information also was provided to indicat the relative importance of streams as fisheries The methods used to determine the rankings ar described by Graham (1986). These method were reviewed by other state and federal agen cies. For the EIS's purpose, the labels assigne to the value classes probably are less importan than the numeric rankings that show difference among streams. The intent of the ranking i being interpreted correctly as long as the reade understands that value class 1 streams are na tionally known, while the value class 5 stream have relatively low fish densities, smaller propor tions of large fish, lower recreational use, fe rare fish, or are not judged to have special aes thetic values.

e) Information concerning the use of certai streams for spawning.

This information is included in DFWP's appli cation and simply states which tributary stream are used for spawning by fish from other stream and reservoirs. This listing describes known oc currences of spawning and may not be complet because streams that have not been inventorie are not listed.

f) Amount of water necessary to maintain riffle and side channel habitat.

The amount of water necessary to maintain riffles, as determined by DFWP, was used as an indicator of aquatic habitat conditions. Potential for misleading results does exist as described below and in Appendix C.

The wetted perimeter method is based on the assumptions that aquatic organisms making up the majority of food for gamefish are produced in riffle areas and that food supply for fish is a major factor in determining the number and weight of fish a stream can support. However, as noted on page 202 of the draft EIS, many factors interact to determine the number of fish a stream can support. The WETP method directly addresses only one of the factors that determine the number of fish a stream would produce.

On each of the seven streams for which DNRC adopted the WETP method to analyze impacts in the draft EIS, more than one riffle cross-section was used to demonstrate the relationship between the amount of wetted perimeter in riffles and flow. Because usually there are differences in riffle shape and size, it is not unusual to find differences in the flow-versus-wetted-perimeter curves for each riffle cross-section. Using one riffle cross-section to show the amount of flow needed to maintain aquatic habitat will be reasonable for that cross-section but may be either high or low for other riffles on a stream reach. Table 3-15 indicates the number of riffle cross-sections used on these seven streams.

g) Estimates of fishing pressure.

The source of this information is statewide angler surveys conducted by DFWP for the years from 1982 to 1986. Because the survey is a random survey of resident anglers, the potential for bias appears low.

Table 3-15. Number of riffle cross-sections used to determine the flow-versus-wetted-perimeter curve on streams for which the WETP method was adopted for the draft EIS

Stream	Number of Riffle Cross-Sections
Gallatin River near Logan	2
Dearborn River	4
Smith River above Hound Creek	7
Sun River above mouth	2
Marias River	4
Judith River	5
Hound Creek	6

h) Estimates of non-angler use levels.

The probability of bias in this information appears low since it has been reviewed by federal agencies with recreation management responsibilities.

i) Location of recreation sites.

This information appears unbiased since little is to be gained from trying to hide recreation sites.

j) Anecdotal information for specific river segments.

Anecdotal information was used in the recreation sections of Chapters Four and Six of the draft EIS. The potential exists for some of this information to be biased, but often the best source of descriptive information is from those DFWP representatives charged with managing the resource who have firsthand knowledge of activities and water levels on a given stream.

k) Estimates of fishing use of Montana River subbasins.

Because this information came from a random sample of resident anglers, the potential for bias is low.

l) Effects of changes in water levels at Canyon Ferry.

This information came from the *Hauser Reservoir Management Plan* (DFWP 1989), a published document that has been reviewed and commented on by other agencies and the public.

m) Crop damage by wildlife.

See response to comment 312.

311. **Comment:** It is obvious that DFWP and DHES have been deeply involved in the preparation of the EIS for the past several years. Members of the public, particularly those involved with irrigated agriculture, have been given two months to comment on the statement. The state agencies also have had years to prepare for the "case hearing," whereas agriculture has been given a few months.

Response: DNRC obtained information for inclusion in the draft from many sources, including DHES and DFWP. Conservation districts (which represent agriculture) and municipalities have been involved in the reservation process since at least 1985, and many prepared applications. They were aware from the beginning of the process, as were state and federal agencies, that an EIS would be prepared and a contested case hearing held. Scoping meetings were held in July 1989 to allow the public an opportunity to identify issues to be addressed in the draft EIS.

312. **Comment:** Who put together the analysis in the draft EIS? What was DFWP's role in putting together the analysis (e.g., they noted impacts to natural vegetation and damage to crops)?

Response: DNRC and its consultants prepared the analysis presented in the draft EIS. Because DFWP is the state agency responsible for managing wildlife in Montana, DNRC requested certain information from DFWP concerning wildlife populations that might be affected as a result of proposed irrigation projects. This and additional information from project-specific environmental assessments and DNRC's consultant were used to prepare the wildlife and vegetation sections in the draft EIS.

313. **Comment:** DFWP has had four years to prepare this document, and existing water right holders had only 60 days during the fall harvest season to read, understand, and comment on the entire document.

It is a particularly incestuous situation that DNRC and DFWP have with this document. DNRC's responsibility is to provide a fair, unbiased, and accurate draft EIS. Instead of doing this, DNRC simply went to DFWP and asked them to support DFWP's position. DFWP then had four years to create studies supporting its position. DNRC relied on DFWP personnel using DFWP methods to create DFWP studies to support DFWP's position instead of drafting what should be an unbiased draft EIS.

Response: As preparer of the draft EIS, DNRC made every effort to produce a fair, unbiased, and accurate document. Because DFWP is the agency responsible for managing the state's fisheries, wildlife, and recreation resources, DNRC relied on DFWP in some instances for associated data. Also see response to comment 310.

314. **Comment:** The draft EIS is based on what is, in some instances, pure conjecture. By BUREC's own admission, "Sufficient information is not available on project design, location, or operation to conduct a thorough evaluation of impacts at this time" (*Draft Environmental Assessment of the Application for Reservation of Water for the U.S. Bureau of Reclamation*, 6).

Response: BUREC intends to prepare a separate federal EIS before constructing the Virgelle diversion project (see p. 154 of the draft EIS). Recognizing this fact, DNRC did not analyze all of the project's potential impacts.

315. **Comment:** BLM has surmised that instream reservations could "limit possible future consumptive water uses, such as industrial or agricultural diversions in situations where water would be fully appropriated." However, the draft EIS does not fully explore what the possible effects could be on existing or future agricultural practices.

Response: See pages 175 and 179 of the draft EIS.

OTHER

316. **Comment:** The City of Lewistown does not want the Board to allocate all of the Big Spring Creek flow to DFWP for instream flow purposes. The City feels that if the Board does so, the City may have to purchase or condemn water rights in the future.

Response: DFWP has applied to reserve 110 cfs for instream flows in Big Spring Creek from the state fish hatchery to the confluence of Cottonwood Creek, and 100 cfs from the confluence of Cottonwood Creek to the mouth. The water reservation statute, however allows only one-half of the average annual flow of gauged streams to be reserved. This limits the Board to granting a maximum of 53.5 cfs for instream flows in the gauged upper reach of Big Spring Creek. The data in Table D-1 of the draft EIS (pp. D-3 through D-20) indicate that streamflows in the section of Big Spring Creek above Cottonwood Creek do not drop below 53.5 cfs, the maximum amount the Board could grant to DFWP.

The lower section of Big Spring Creek, where DFWP has applied for 100 cfs, is ungauged. Table D-1 also indicates that flows in this lower stream reach sometimes are less than DFWP's request, especially during the fall. Therefore, DFWP's request, if granted could preclude future appropriations of water upstream. Lewistown would have to purchase or condemn water if its water rights were insufficient to cover its future needs.

317. **Comment:** I [Joe Gutkoski] recommend no further irrigation diversion from the Jefferson, Madison, and Gallatin rivers. The purpose of the water reservation process is to evaluate the levels of the water (existing supplies) and not overallocate the stream. Salt and nutrient water problems caused by irrigation should not be allowed.

Response: Your comment is noted. See page 1 of the draft EIS for a discussion of the purpose of the Missouri basin water reservation proceeding.

318. **Comment:** We [Glacier County Conservation District] object to DFWP's applications for reservations on streams in the Missouri River basin that are filed on streams that already may be fully appropriated, and to those applied-for reservations that would preempt any potential water reservations that conservation districts have found to be feasible.

Response: Nowhere in the draft EIS is the statement made that reservation requests from DFWP will preempt those of the conservation districts. The Board is responsible for setting the priority among any competing applications that it may approve (§ 85-2-331, MCA).

319. **Comment:** While I [Monte J. Boettger, Lewistown City Attorney] agree that planning for the future is important, no plan can be accurate without having the basic ingredients. In this case, how much water is there that can be reserved? Depending on what this answer is will greatly affect any public entity's future plans and, hence, proposed reservations. The EIS does not address this, to put it mildly, rather important point. More importantly, the whole reservation process fails to adequately deal with this.

Response: Information regarding streamflows in the Missouri River basin is presented in Chapter Four under "Water Quantity and Distribution" (p. 41) and in Appendix D of the draft EIS. The effects reservations would have on streamflows are discussed in Chapter Six under "Water Quantity and Distribution" (p. 154) and in Appendix C. Chapter Four, "Legal Water Availability in the Missouri Basin" (p. 54), and Appendix A provide information on existing claims to water in the basin. Also, Chapter Six, "Legal Water Availability" (p. 175), discusses the legal availability of water for reservations and effects on existing water users.

The Board will decide whether the proposed reservations would have any adverse effects on the use of existing rights. The reservation process requires that existing water right holders be notified of any reservation applications that may affect them and that they be given the opportunity to voice their objections or concerns at a contested case hearing. Findings of fact and conclusions of law from the contested case hearing will be provided to the Board to help it reach a final decision.

320. **Comment:** The draft EIS does not adequately take into consideration the fact that requested flows are so large that development of future groundwater or surface rights by private parties will be virtually impossible.

Response: A discussion of how reservations may affect the availability of water for future appropriation is provided on page 179 of the draft EIS.

321. **Comment:** The applications for water reservations and the EIS should conform to provisions of a comprehensive water management plan for the headwaters portion of the Missouri River basin. Without a comprehensive plan, it is impossible to administer the basin or address the effects of the applications. A comprehensive plan first should be approved by the governing bodies of the counties, cities, towns, and conservation districts and then submitted to DNRC and the state legislature to be made part of the state water plan. Based on the approved comprehensive plan, a thorough EIS can be prepared and applications can be analyzed and granted or rejected.

The upper Missouri River basin and the uses of its water are so important to the citizens of Montana and, in fact, to the entire nation, that the process should not be rushed or addressed without a comprehensive understanding of all factors and their environmental, economic, and social impacts.

Response: The legislature has required the Board to reach a decision on the applications by July 1, 1992. The Missouri River reservation process is a comprehensive basin plan. Preparing the applications involved active participation by most user groups such as agriculture through their local conservation and irrigation districts, municipalities, and federal and state agencies. The process also includes a review of and comments on a comprehensive EIS for the reservation applications, extensive public involvement, a contested case hearing that involves all affected parties, and a decision by the Board, which has to consider a number of clearly defined criteria—including those related to public interest.

322. **Comment:** How will the instream flow requests fit into the statewide water plan?

Response: One section of the state water plan addresses instream flows. Water reservations for instream purposes are recognized in this section as being the best way to protect unappropriated instream flows.

323. **Comment:** The Teton County Conservation District believes that with a modicum of common

sense, the goals of all of the reservation requests can be met. It will require a concerted effort from all of the parties involved to identify this solution, but we believe it will be worth the effort to find it.

Response: Comment noted.

324. **Comment:** Water reservation plans should be analyzed to make them consistent with various other plans and perhaps be contingent on state-level plans.

Response: Your comment is noted. The reservation process and its implementation in the Yellowstone River basin is a basin management plan. The Yellowstone River reservation process considered existing water rights along with economical, social, and environmental issues. It recognized water uses for industry, irrigation, recreation, fish and wildlife habitat, water quality, and municipal use. The state water planning process would consider the same types of issues and water use as the Missouri basin water reservation process.

325. **Comment:** Are the methods used in the analysis for the draft EIS "state of the art"? The methods should be described in the EIS and included as an appendix—specifically, a description of the water availability model.

Response: The methods used in the draft EIS analysis are those felt by DNRC to be most appropriate, given the number of applications to assess and technical and time constraints. The appendices include information on some of the analysis methods used in the draft EIS, including the methods used to determine instream flows needed to protect aquatic habitat, the Missouri River water availability model, and information from the recreation survey and economic analysis. More detailed explanations of the methods used in the Missouri water availability model, the recreation survey, and economic analysis are available from DNRC.

326. **Comment:** Why is all this new irrigation needed in the Missouri River basin above Great Falls?

Response: DNRC's analysis focused on the economic and financial feasibility of the irrigation projects. The Board will make the final decision on whether the reservations are needed.

327. **Comment:** Clarify where DFWP instream flow requests begin and end on Big Spring Creek. Does the request include flows from the Big Spring, in pipes from the spring, or flows passing through the state fish hatchery?

Response: In its application, DFWP requests reservations for streamflows in Big Spring Creek from the outflow from the state fish hatchery (Section 5, Township 14 North, Range 19 East) to the confluence with the Judith River (Section 76, Township 17 North, Range 16 East). The request is for streamflows in the natural channel of Big Spring Creek. DFWP did not request a reservation for flows from Big Spring itself, for flows passing through pipes from the spring, or for flows passing through the state fish hatchery.

328. **Comment:** The mining pumping project (LM-20) should be considered for municipal and industrial uses instead of irrigation.

Response: The Lower Musselshell Conservation District applied to reserve water from the Roundup mines for irrigation only. Notice to the public was given based on the present application, and affected persons were given the opportunity to object to the proposed reservation. No request to alter the application has been received. If such a request is made, the hearing examiner appointed by the Board must rule on whether the application may be altered to substitute new proposed uses. Public notice and opportunity to object would be required if such a request were granted.

329. **Comment:** We [Skyline Sportsmen's Association] feel it is inappropriate that this process is being pushed forward before a complete adjudication of water rights is completed on the entire Missouri River basin. The entire basin is beset with a water shortage year after year. The basin would be much better served with the implementation of measuring devices to keep the use of water to the amount allowed by the rights—not whatever the user decides to take from the rivers.

Response: See response to comment 9 regarding the adjudication process. Your comment regarding measuring devices is noted.

330. **Comment:** The draft EIS does not address alternatives to irrigation projects proposed in the basin. Crop choice definitely impacts irrigation water needs and should be addressed.

Response: DNRC thought it resonable to use the crop irrigation requirements for alfalfa because it is commonly grown in the basin. In most instances, the conservation districts based their requests on the consumptive use requirements for an alfalfa crop.

Two exceptions should be noted. Project GA-201 included a rotation of potatoes, small grains, and alfalfa (see response to comment 259). BUREC's project may include irrigation of bluejoint hay in addition to alfalfa. Also see response to comment 339.

331. **Comment:** There is no basis for the statement on page 180 regarding the applications by federal agencies that "... it is unlikely there would be conflicts with the proposed new consumptive uses, most of which would be at lower elevations."

Response: DNRC examined the locations of reservation requests for consumptive use and found few that requested water from stream segments on or above National Forest land.

332. **Comment:** The draft EIS does not adequately explore whether there is a "reasonable likelihood that future in-state or out-of-state competing water users would consume, degrade, or otherwise affect the water available for the purpose of the reservations."

Response: This issue is described in Chapter Three of the draft EIS for each application and evaluated in Chapter Seven. In addition, the Montana Legislature initiated the Missouri basin reservation process in 1985 based on two reports: (1) a lengthy report titled *A Water Protection Strategy for Montana: Missouri River Basin* (Trelease et al. 1982), and (2) a report of the Select Committee on Water Marketing submitted to the 49th Montana Legislature in January 1985. Both reports concluded that Montana should begin a reservation process in the Missouri basin to protect Montana's water from downstream appropriation.

333. **Comment:** Throughout the draft EIS, it is impossible to cross-reference any of the data as it is presented [to determine where the data came from].

Response: The reference section of the draft EIS gives all sources of information that were not generated by DNRC. Methods DNRC used to acquire data are explained throughout the EIS and appendices.

334. **Comment:** The draft EIS seems to be more sensitive to instream flow applications, emphasizing their status quo character and minimizing the benefits that might arise from additional consumptive uses without actually equating the incremental effects on the aquatic environment.

Response: The intent of the EIS was not to emphasize one type of reservation over another. One conclusion that could be drawn from the draft EIS is that instream reservations would tend to maintain the status quo, except that permits issued since July 1, 1985, would be junior to these reservations. The benefits that would arise from proposed consumptive uses were described in the EIS, as were the impacts that would result from the reservations for consumptive use. In the environmental assessments, DNRC examined local effects of using reservations for individual municipal and irrigation projects. The effects of many individual irrigation and municipal reservations on the aquatic environment, when considered by themselves, are small.

335. **Comment:** Environmental impacts were not assessed, in our [Montana Water Resources Association] opinion, as beneficial—only detrimental.

Response: Chapter Six of the draft EIS discusses impacts that proposed reservations may have on the affected environment. The impacts discussed include those that could be considered beneficial along with those that could be thought of as detrimental.

336. **Comment:** In reference to page S-2 of the summary, how are impacts looked at or assessed? Only as negative? Or as both negative and positive? Whose point of view? It is suggested that more positive than negative attitudes be conveyed so far as being able to address all interest groups. Individual interest groups tend to be against concerns that impact against them initially. We [Ole M. Ueland] need a better explanation of how Montana citizens, society, and consumers of water use products benefit in the long run.

Response: DNRC attempted to identify short- and long-term impacts—whether positive or negative—in the draft EIS. Many reservation requests show both positive and negative impacts. Chapter Six of the draft EIS explains these impacts in detail.

337. **Comment:** Is combination use multiple use? How are return flows related to the above? What is the percentage of depletion of water that originates in the Missouri basin to where it leaves its borders? What management strategies can be devised to put this water to more beneficial uses before it leaves the basin and Montana?

Response: The Combination Alternative includes reservations for municipal use, irrigation, and instream flows and could, as with other alternatives, be considered a "multiple use" alternative. Return flows from projects included under the Combination

Alternative would be available for instream or other consumptive uses. Excluding reservoir evaporation, approximately 9 percent of the water originating in the Missouri basin of Montana is consumptively used in Montana. Water in the Missouri basin can be put to such consumptive beneficial uses as irrigation and municipal, or it can be used beneficially instream for fish, wildlife, and recreation before it leaves the state. The water reservation proceeding is one management strategy that can be used to allocate water in the Missouri basin for beneficial uses.

338. **Comment:** An additional table should be added to the draft EIS. This table would list those streams and stream reaches where conflicts occur among the applicants. The table should list who is in conflict, e.g., instream and irrigation; or instream and municipal; or instream, municipal, and irrigation. This addition would make it much easier to identify where conflicts do or do not occur and to measure the impacts of the reservation applications.

Response: The revised Appendix Table K-3 (see "Changes to Draft EIS") lists all instream reservation requests that have no competing consumptive reservation requests (irrigation or municipal). This table shows that about 85 percent of the instream requests have no competing consumptive requests. Appendix B lists consumptive reservation requests that may compete with other consumptive requests. Revised Appendix Table K-5 (see "Changes to Draft EIS"), which lists instream flow reservation requests that have competing consumptive requests, shows that about 15 percent of the instream requests have competing consumptive requests.

The following table (Table 3-16) summarizes this information.

Table 3-16. Summary of reservation requests with competing requests by subbasin

Subbasin	Number of instream requests with no competing requests (from Appendix Table K-3)	Number of consumptive reservation requests with potentially competing requests (from Appendix Table K-4—now Appendix B)	Number of instream requests with competing consumptive requests (from Appendix Table K-5)
Headwaters	183	37	14
Upper Missouri	45	98	19
Marias/Teton	13	57	6
Middle Missouri	25	47	13
Basin Total	266	239	52

339. **Comment:** [Because of the detailed nature of this comment and the overlap between resource areas in the comments, DNRC has responded to the letter as a whole.]

The organization and content of the major component models/modules that collectively support the draft EIS demonstrate careful thinking. Nevertheless, the current forms of the overall model and results are unsuitable for supporting decisions of this size and level of potential health consequences. In particular,

— the effects of data and estimation uncertainties are incompletely/not brought forward to the final results

— there is insufficient qualitative/quantitative assessment of the impacts of assumptions used in the component models on the final results (e.g., bias) nor of the impacts on results of changes in those assumptions

— the scenarios examined do not relate well to the permitting decisions that will ultimately occur.

The selective permittings that will likely occur do not relate very clearly to the scenarios examined, and there is no indication of the quality of decisions examined in this draft EIS, not to mention the quality of decisions that will actually occur. Therefore, decisions made by use of the current EIS results will not be defensible before the scientific community, the legal community, or the general public.

Data and Estimation Uncertainty

Although each of the criteria results reflect either an incomplete accounting for potential random variability or no consideration of variability in the estimated criteria, the following discussion will be restricted to the water quality criteria.

No variabilities are given for the total dissolved solids (TDS) estimates (draft EIS, p. 182, Figure 6-19). For the arsenic estimates, only the effects of temporal fluctuations in flow have been considered. Additional sources of variability in the arsenic estimates include (at minimum):

— spatial variability (from sample location in stream)

— long-term ("batch") and short-term (duplicate-to-duplicate) chemical analysis variability

— uncertainty in prediction using the arsenic-flow model

— flow measurement variability

Under an idealized (normal-theory) assumption, the standard deviation of the arsenic estimator with a mean of 135 micrograms per liter (Table 6-11, draft EIS, p. 187) is increased by about 25 percent when the (underestimated) prediction error s.d. of the concentration model is included. It would increase further after considering the additional sources of variability. Furthermore, since river flows can themselves be considered to have long-term, non-stationary characteristics and since flows may also change consequential to climate variation (draft EIS, p. C-5), the 58 years of historic data do not necessarily contain a significant portio of the variability in the flow. Last, positive correlations among the above components of uncertainty may further augment the variability in concentration estimates; e.g., low streamflows in the past may have worsened the ability to do river sampling using the "equal width" or "equal flows" method.

There are obviously many potential sources of variability in the estimates of impacts of permitting decisions on recreation, irrigation, and hydropower as well as the arsenic concentrations. Rather than attempting to identify all of the sources and quantify their contributions, an uncertainty analysis could be done by randomly sampling the major random variables, each time computing the results associated with the sampled components/model terms, and assessing the distribution of the output results after all the runs have been made. An efficient approach to this sampling is to construct individual probability distributions (using expert opinion, anecdotal information, etc.) for each of the random components and sample from distinct sub-intervals of each distribution using a latin-hypercube design. Furthermore, this method can impose user-specified correlations between the random components to achieve correlated sampling. The final result of these runs is often expressed as either a cumulative distribution function (CDF) or its complement, the complementary CDF, (CCDF = 1-CDF) (reference 5).

Sensitivity to Assumptions

As with the understatement or absence of variabilities of the criteria results, there is neither a clear qualitative nor quantitative assessment of the sensitivity of the results to changes in assumptions, models, or approaches. One is "left cold" after looking at the results. Although it is not necessarily dubious to make simplifying or "complexifying" assumptions, it is incumbent upon the modeler to provide the decision-maker with indications of the quality of the results (both in terms of uncertainty and sensitivity).

This sensitivity or sturdiness ("robustness") of the results is often determined by making differential changes in pre-specified parameters (e.g., parameters that are known only imprecisely, or for which a range of values exists) and rerunning the models, or—if possible—determining numeric or analytic derivatives of the results with respect to the parameter changes. Also, discrete changes may be made such as altering choices of models or their subcomponents and rerunning the overall system. These sensitivity results may then be amenable to describing in terms of a response surface as a function of the parameters or model choices. The total (instead of partial) sensitivity of an estimate to changes in the parameters/models could be obtained by treating the selections as random variables and doing an uncertainty analysis as described above.

Selection of Scenarios

The choices of scenarios seem to be "bounding" cases, but not representative of the decisions that will occur. Consequently, the actual distribution of resulting costs and benefits from actual decisions are not reflected in the three primary scenarios. It is understood that other scenarios were examined. However, they were selectively chosen. It appears plausible to cast the determination of projects into an optimization framework where constraints on the selections could include costs, potential health effects, and other of the decision criteria examined, as well as constraints on variabilities of each of them.

Specific Comments

The following are comments that relate to specific modules/efforts that support the draft EIS.

Water Quality

Sampling for Arsenic. The sampling design for arsenic does not support the estimation of spatial, vertical compositing, or analytical batch components of variability.

Arsenic-Flow Relation.

— The induced uncertainties of the arsenic estimates from uncertainty in flows, estimation, and data sampling and analysis should be quantified.

— The empirical model appears to fit fairly well, but it does not account for the return of arsenic through the irrigation-charged groundwater. I recommend the use of a conservative transport model to account for this return "source" to the river, such as MEPAS.

— The conservative (no-interactive) transport assumption may be reasonable for use in upper-bounding the arsenic concentrations, but this, like other modeling assumptions, should be examined through the use of the sensitivity analysis.

Arsenic Health Risks. A corresponding table of arsenic health risks should be presented with the concentration estimates.

Recreation Valuation

The variation in estimates of recreational values does not include the variation attributable to the uncertainty in flow nor the variation associated with sampling in the survey.

— The prediction error variability should have been used in equation 24 (and done with the inclusion of the flow uncertainty).

— If actual reduced flows were available in lieu of hypothetical ones, the standard deviations in Table 41 would be underestimated, since flows are random processes. Since the responses at the alternate hypothetical (unrealized) flows were themselves hypothetical, then either (1) the parameter estimates are very likely biased and/or (2) the uncertainty associated with the estimators is understated. A statistical Bayes framework might be more appropriate for both the parameter estimation and qualitatively assessing the parameter uncertainties (e.g., by respectively using the posterior expectation and posterior variance.

Economic Benefits to Agriculture

— The sensitivity and uncertainty of the economic benefit estimates (Table 6-44, draft EIS, p. 233) are not given. Presumably, an input-output model was used to make these assessments; such a model has intrinsic uncertainties and inaccuracies that should be brought forward with the results. Furthermore, the variability in the financial results from the irrigation model should also be propagated through in quantifying the uncertainty of the economic benefit estimates.

— The uncertainties associated with the financial results from running the irrigation model are underestimated in that variability in the average yield curve is not considered, and variabilities in most of the model regressor terms and their associated parameter estimates are not considered.

Recommendations

Model Integration. Each module/effort should be put into model form (if it has not been done) and all models integrated or coupled into a large model. This format is preferable to a linkage of spreadsheet or hand calculations in that (1) the "quality assurance" level of integrity is improved through better traceability of results (e.g., for audits), and (2) rerunning the model is many times more efficient.

Uncertainty Analysis. An uncertainty analysis should be done. This analysis should (1) reflect randomization of all/major parameters that are subject to random fluctuation and (2) be done by simultaneously randomizing these components within each module and across modules (also simultaneously). The latin hypercube sampling (LHS) technique is an efficient approach to performing this analysis. The output from such a method is N alternative sets of parameter values. The system of model/modules is then run using each of these sets of parameter values. After the N model runs are made, a discrete cumulative probability distribution function is tabulated for each of the decision criteria. This will provide the decision-maker with an indication of (approximate) potential variability and extremeness in the criteria estimates, and the results can be conditioned accordingly.

Sensitivity Analysis. The sensitivity of the decision criteria estimates to changes in (non-random) parameters or model/module approach alternatives can be assessed as previously described. This will provide both (1) a basis for specifying qualifications on the results and (2) a foundation for making model improvements where they are most effective.

Arsenic Groundwater Transport Model. I [Dr. Peter Chamberlain] recommend that a conservative transport model be included to account for the groundwater return of arsenic to the river. The MEPAS model has been used by state agencies for a variety of sites and has potential application here.

Selection of Specific Projects. The model should be modified to accommodate a range of alternative permitting projects. The optimal set of projects could be identified through a constrained optimization algorithm such as quadratic or linear programming. If constructed properly, such models can adequately consider spatial and temporal features of the problem as well as consider risk constraints.

Response:

INTRODUCTION

Estimates of streamflows, costs, benefits, and impacts to the environment are uncertain. In an ideal world where analyses are without cost, assessments of environmental impacts would follow paths similar to those recommended. Probability distributions would be determined, sensitivity analyses carried out, and analyses of risk would be made to assess the consequences that incorrect decisions may have on people and their environment. DNRC did not feel it was necessary for this EIS to make all of these analyses. Those done are adequate to assess impacts of proposed actions. However, many of Dr. Chamberlain's comments and concerns are addressed, and these are presented for each resource area.

WATER QUALITY

DNRC agrees that the arsenic estimates presented in the draft EIS (see Table 6-11) are subject to considerable estimation error and uncertainty. Potential sources of uncertainty include sampling variability (spatial cross-section variability), analytical variability (lab methods, procedures), and arsenic concentration model prediction error (e.g., regression model uncertainty). Arsenic data were collected by USGS. The equal-discharge or equal-width increment sampling methods were used to provide a cross-sectional and depth-integrated sample that accounts for spatial variability.

The Missouri River at Toston is part of the USGS National Stream Quality Accounting Network. Water quality data for this network are collected at a fixed station sampling frequency designed to minimize temporal sampling problems such as serial correlation. Dissolved arsenic concentrations that form the basis for Table 6-11 were determined by the USGS National Water Quality Laboratory. The laboratory participates in several quality assurance programs designed to monitor and maintain specified levels of accuracy and precision for various parameters. Quality assurance data for USGS's National Water Quality Laboratory's Blind Sample Project provide the following information on the laboratory precision of arsenic analyses.

Total dissolved arsenic samples from 1985 through 1990 were analyzed by graphite-furnace, atomic absorption spectrometry. For combined total and dissolved arsenic analyses, the relative standard deviation (RSD) of arsenic concentrations ranges from 0 to 40 percent of the mean over the concentration range of 1 to 15 micrograms/liter. Lab samples typically are diluted as much as five-fold for analysis with a target concentration range that provides the smallest standard deviation and greatest precision. A reported concentration of 25 micrograms/liter, with a five-fold dilution, would have a RSD of 20 percent. This indicates that about two-thirds of samples analyzed in this range are within ±5 micrograms of the reported mean value (25 micrograms/liter).

Estimates of the effect that the Consumptive Use Alternative would have on *dissolved* arsenic concentrations (see Table 6-11) are based on an empirical regression model that relates arsenic concentration to streamflow. An exponential model was fit to 53 paired observations of discharge and concentration using non-linear, least-squares methods. Confidence intervals (95 percent) for the values shown in Table 6-11 are large due to the variability of the concentration data and the limited number of observations for discharges of less than 3,000 cfs. For example, 95 percent confidence intervals on arsenic for the median (50 percent) baseline flow reported in Table 6-11 in the draft EIS extend from 88 μg/L to 25 μg/L. Because of the broad confidence limits, the absolute values of the estimates are less meaningful than comparison of the relative magnitude of the estimated increase in concentration. Rather than report confidence limits for all estimates, the estimated percentage increase in arsenic concentration for the median (middle) regression estimates is given.

The empirical model described above does not explicitly route arsenic in irrigation return flow. However, the concentration effect of consumptive depletion is implicitly accounted for in the estimates of depleted flow. The analysis assumes that arsenic is nonreactive and that arsenic load is constant. Under these assumptions, reduction in streamflow results in a proportional increase in dissolved arsenic concentrations.

Increases in TDS as a result of new irrigation development were based on data for existing TDS concentrations, which were sparse, estimates of water use by crops, and formulas for estimating salinity concentrations in irrigation return flows (Novotny and Chesters 1981). These data were not sufficient for in-depth statistical analysis. The purpose of the calculations was to determine whether the proposed irrigation projects would cause TDS to exceed the public drinking water standards. The results of this analysis are presented in Figures 6-19 and 6-20 of the draft EIS. They show that the Sun River is the only major stream where new irrigation may increase salinity levels above the standard, and only if reservations are granted for all irrigation projects.

It was recommended that the multimedia environmental pollution assessment system (MEPAS) be included to account for the groundwater return of arsenic from irrigation return flows to the Missouri River. MEPAS is a comprehensive integrated methodology used to assess health risks resulting from actual or potential releases of hazardous materials into the environment. MEPAS was developed for the purpose of modeling relatively site-specific impacts (i.e., effect of waste repository on immediate environment), and not basinwide watershed processes controlling agricultural nonpoint pollution. Data requirements and spatial resolution required to model the Missouri basin preclude application of MEPAS. Components of the overall MEPAS model (e.g., groundwater contaminant routing) may have application in ongoing efforts to develop an arsenic water quality model.

We agree that determining uncertainty is an important aspect of decision-making, especially regarding effects on water quality. Given the time and funding constraints and the availability of information in the various resource areas, a detailed uncertainty analysis was not done. Numeric arsenic and dissolved solids estimates given in the EIS represent the best estimates possible with available data. In many situations, data deficiencies precluded numeric estimates of water quality impacts, and professional judgment was used to make qualitative assessments.

RECREATION SURVEY

(The following three sections refer to the report *Instream Flows in the Missouri River Basin: A Recreation Survey and Economic Study* (Duffield et al. 1990).)

UNCERTAINTY IN VALUE ESTIMATES DUE TO VARIATIONS IN FLOW AND SURVEY SAMPLING

The sampling variability in recreation estimates is included in all recreation value estimates in Chapter Five—that is *the* source of variability in the logit model used to derive these estimates. In Chapter Six, the variability in the derivative of the flow/visitation equation estimates was not included in the estimates of marginal values (Tables 42-45), as was pointed out on p. 40. This is because of the nature of the data. The points to which the curve was fitted (Figure 2, p. 39) are dependent since they represent cumulative responses. In addition, the estimated parameters of the flow curve are correlated with the economic value estimates since they are based on the same individuals. Although it might be possible to develop a convoluted method to attach standard errors to the derivatives, it does not seem necessary in view of the quality of the responses to these questions. As we point out on p. 42 in "Limitations of the Flow Analysis," many respondents may not have understood the flow question. It is also probable that many people aren't certain what different flow levels really look like. Finally, these responses reflect only hypothetical behavior. Observed behavior (i.e., on-site use data) over several years would provide much better estimates of responses to various flow levels, but this procedure was beyond the scope of this study.

The commenter is correct that variation in flow levels was not taken into account. Variation occurs from day to day, season to season, year to year, and point to point along the river. We would not expect day-to-day variability to be a significant source of error. We attempted to account for seasonal variability by dividing the year into "July-August" and the rest of the year. We did not have enough detailed information on the location of individual respondents' recreation or on flow to account for point-to-point variability. We assume this is not a significant source of error. Also, we did not attempt to account for the year-to-year variability in flows and therefore in marginal values. Our data are for one year only, and individuals' responses reflect the actual flows experienced that year. Our estimates and standard errors are for extrapolation to that year only. Since we do not have data on other years, we cannot assess how year-to-year variability in flows will affect responses. Since this year was not unusually low or high in terms of flows, the values derived probably would represent something near the average.

The estimated standard errors on the marginal value estimates in Tables 42-45 are therefore very conservative for extrapolation to future values. However, we don't see a reasonable way to come up with more reasonable estimates given the nature of the data.

VALUE OF INSTREAM FLOW FOR RECREATION

We assume that the comment regarding prediction error variability in equation 24 refers to the use of the prediction error in predicting an individual response at a particular x in regression instead of the standard error of the mean response at a particular x. The purpose of our study was not prediction of an individual future value. In general, it seems more appropriate to calculate standard errors for an average response rather than for an individual prediction.

FLOW VARIABILITY EFFECTS ON THE NUMBER AND QUALITY OF RIVER TRIPS

This comment has been partially addressed in the response above on uncertainty in value estimates due to variations in flow. The suggestion of a Bayesian analysis for the flow data is a good one. However, we suggest the following framework: various experts, including recreation specialists, guides, and experienced users, would be polled as to their guesses about the effect of reduced flows on visitation and the quality of trips on various rivers (perhaps panels of these individuals could meet jointly).

From these opinions, prior distributions on the parameters of interest would be developed. These would be combined with on-site and/or mail survey data to arrive at posterior estimates and distributions.

ECONOMICS

In Chapter Two, the sensitivity of the economic model to changes in power costs and assumptions made regarding return flows is examined. Economic analyses also were conducted for two additional alternatives in this chapter. Other assumptions that could be subject to change in the economic model include labor costs, crop type, total income, and taxation. No sensitivity analysis was conducted for these assumptions because they were calculated using the best available information as described below.

Labor requirements were determined using information from the SCS Montana Irrigation guide (SCS 1973), assuming a four-month irrigation season and labor costs of $5.00 per hour. Agriculture sales were estimated assuming a crop rotation with seven years of an alfalfa crop and barley planted every eighth year. Total income was estimated using the median (middle) net income figure as computed by DNRC. State taxable valuations were estimated by computing the average taxable valuation of irrigated acreage, less the average taxable valuation for nonirrigated acreage, and multiplying this by project acreage. The change in county tax receipts was estimated by multiplying county operations and school mill levies by percentage increases in state tax valuations as calculated above.

MISSOURI RIVER WATER AVAILABILITY MODEL

DNRC conducted sensitivity analyses for the Missouri River water availability model to determine how model results would change if the input data were inaccurate. Examined was the sensitivity of model results to changes in the values of four input files: irrigated acres, irrigation efficiencies, crop irrigation requirements, and groundwater return flow factors. The following are results of these analyses.

IRRIGATED ACRES

Irrigated acres were entered into the model for each irrigation system type at each of the 35 locations where streamflows were modeled, and for each year of the 1929-to-1986 base period. For the sensitivity analysis, irrigated acres used in the baseline model run presented in the draft EIS were raised 10 percent and then lowered 10 percent. Output data from these model runs then were compared with those for the baseline run. Table 5 of Appendix A presents selected results of this analysis.

In general, model results are quite sensitive to changes in irrigated acres. For example, in the Jefferson River, estimated streamflows changed by 23 to 82 percent in July, and by 39 to 176 percent in August. Canyon Ferry outflows varied by up to 24 percent in July and 15 percent in August. In the Missouri River at Fort Benton, estimated streamflows varied up to 23 percent in July and 19 percent in August. Inflows to Fort Peck Reservoir also changed by up to 23 percent in July.

IRRIGATION EFFICIENCIES

The efficiency of the irrigation system determines how much water must be diverted for each acre-foot needed by crops. The sensitivity of model results to changes in irrigation efficiencies was examined. Irrigation efficiencies were raised and lowered from those used in the draft EIS as presented in Table 3-17. Selected results from this analysis are presented in Table 6 of Appendix A.

Table 3-17. Irrigation efficiencies used in the draft EIS and the sensitivity analysis

	Efficiencies		
Type of Irrigation	Used in draft EIS	Higher value	Lower value
Furrow/Border Flood	0.18	0.22	0.14
Center Pivot Sprinkler	0.49	0.61	0.37
Other Sprinkler	0.34	0.42	0.26
Water Spreading	0.15	0.19	0.11

In general, model results were found to be relatively insensitive to changes in irrigation efficiencies. The largest percentage change in estimated streamflows was 33 percent for the Jefferson River in August. This large percentage change, however, is due primarily to severe low flow conditions during dry years in August. Because the flows already are so low, a small increase or decrease in flows would represent a large percentage change. Monthly outflows from Canyon Ferry Reservoir varied less than 1 percent, and average annual flows also varied less than 1 percent. For the Missouri River near Fort Benton, monthly streamflows varied by no more than 2 percent, and average annual flows varied by less than 1 percent. Inflows to Fort Peck Reservoir varied less than 4 percent for any month and less than 1 percent on an average annual basis.

CROP IRRIGATION REQUIREMENTS

Crop irrigation requirements, the amount of water needed by crops, were entered into the model for each location and for each month of the 58 years of record used. For this analysis, crop irrigation requirements used in the draft EIS baseline run were raised and then lowered 20 percent, and changes in model results were examined. Selected results from this analysis are presented in Table 7 of Appendix A.

In general, model results were relatively insensitive to changes in crop irrigation requirements. The highest percentage changes for the results presented occurred during August of dry years in the Jefferson River. But again, these large percentage changes—as much as 41 percent—are due partly to existing low flow conditions in that stream during dry years. For the Missouri River below Canyon Ferry Reservoir, at Fort Benton, and above Fort Peck Reservoir, maximum monthly changes were about 1 percent. Average annual changes were 1 percent or less at all of these stations.

GROUNDWATER RETURN FLOW FACTORS

Groundwater return flow factors determine the rate at which much of the excess water diverted for irrigation will return to a stream. Return flow factors were entered into the model for each of the 35 locations where streamflows were estimated. The factors used in the draft EIS were multiplied and then divided by 10, and model results were analyzed for sensitivity to these changes. Selected results from this analysis are presented in Table 8 of Appendix A.

Although groundwater return flow factors were raised and lowered dramatically, model results usually did not change much. The largest changes in predicted streamflows occurred for the Jefferson River in August of dry years—as much as 55 percent. But again, these large percentage changes are due partly to existing low flows in the stream in August. Otherwise, monthly changes for the Jefferson River were 5 percent or less. Monthly changes were less than 4 percent for the other stations presented in Table 8 of Appendix A.

OTHER STREAMFLOW ESTIMATES

USGS estimates of existing streamflows were presented in Chapter Four and Appendix D of the draft EIS. Streamflows estimated by USGS also were used as input data for the Missouri basin water availability model.

Monthly mean and percentile streamflows were estimated by USGS for 312 sites in the Missouri basin above Fort Peck Dam (USGS 1989). The estimates were based on data for the water years 1937 to 1986 and were made using several techniques. O
the 312 sites, 100 had gauging station records rang
ing from 2 to 81 years duration. Miscellaneou
streamflow measurement records were available a
139 sites, and 73 had no streamflow records.

For sites where gauging station records wer
available, all incomplete records were extended to th
1937-to-1986 base period. A curve fitting techniqu
was used to develop equations relating commo
monthly data at a site with incomplete records to tha
of one with a complete record. This equation the
was used to fill in the missing data at the site wit
incomplete records. The best station from those avai
able in a region was chosen to fill in each month
missing data for a station. Fifty-four gauged site
with more complete records were used for correlatio
and record-extension purposes. The same techniqu
was used to develop streamflows that served as inpu
to the Missouri basin water availability model, exce
that the period of record used here was 1929 to 198

USGS used five methods to estimate month
streamflows at ungauged sites. Regression equa
tions based on basin characteristics (drainage are
and mean annual precipitation) at gauged sites we
used to provide preliminary estimates of streamflow
at 179 ungauged sites and to provide final estimat
at 52 sites. The standard error of estimates ma
using this technique ranged from 35 to 97 perce
Regression equations relating channel width
streamflows at gauged sites also were used to provi
preliminary estimates of streamflows at 138 site
The standard error of estimates made using this tec
nique ranged from 36 to 103 percent. In anoth
method used, streamflow measurements were ma
at ungauged sites and compared with recorded flo
at similar gauged sites. Equations then were dev
oped on the basis of these comparisons and us
along with streamflow records at the gauge locati
to estimate monthly streamflows at the ungaug
site. This technique was used to provide prelimina
estimates at 139 sites and to provide final estimat
for 14 sites. The standard error of estimates ma
using this technique were estimated to range from
to 111 percent. A fourth method used a weight
average estimate of two or more of the three estim
tion procedures described above. This method w
used to provide final estimates at 139 of the u
gauged sites. The standard errors of these estimat
ranged from 24 to 63 percent.

Seven sites without recorded flows were locat
on streams close to gauged sites or other sites whe
flows were previously estimated. In these instanc
estimates of streamflows at the site of interest we

made by multiplying the estimated streamflows for the known site by the ratio of drainage area of the two sites. Standard errors were not determined for estimates made using this method.

Streamflows for some of the streams presented in Tables 6-23, 6-24, and 6-26 of the draft EIS, and some of those used to calculate flow reductions used in Tables 6-2 and 6-3 of the draft EIS, were estimated by DNRC. DNRC used a regional equation developed by USGS (1984) for streams in the eastern portions of the basin, and those described by Potts (1983) to estimate average annual flows in the western portions of the basin. These equations estimated average annual streamflows based on geography, drainage area, and average annual precipitation. Standard errors of these estimates ranged from 51 to 64 percent for the USGS method, and average absolute errors were 12.5 percent for the methods described by Potts. Monthly average and percentile streamflows then were derived by using the average annual flows and comparing them to average and percentile distributions for similar, nearby streams with gauges.

Streamflow distributions for a few other streams described in the text were derived by using USGS gauging station records for periods of record other than for the 1937-to-1986 or 1929-to-1986 base periods. These flows were derived from gauging station records that usually are accurate.

OTHER CONCERNS

A recommendation was made that all models used in the EIS be integrated into one master model to improve quality and efficiency. This was not done for practical reasons. First, DNRC staff used microcomputers for modeling. These machines don't have the memory that would be needed to store and run all models simultaneously. Also, a specialist on staff is responsible for developing and running each model. Integrating the models would require hiring a computer programmer who thoroughly understands all of the models. DNRC does not have the budget to hire a programmer to integrate all models.

The concern also was raised that the scenarios [alternatives] examined seem to be "bounding" cases but not representative of the decisions that will be made. As stated in Chapter Five of the draft EIS, DNRC developed the alternatives to illustrate the effects of different water use emphases on the existing environment, encompassing a reasonable range of actions that could be taken by the Board. These hypothetical actions range from the Board's granting all reservation requests (the Consumptive Use Alternative) to the Board's denying all reservations (the No Action Alternative). Two other alternatives presented in the final EIS (the Instream and Combination alternatives) represent what could be thought of as intermediate approaches. In addition, Chapter Two of this final EIS analyzes two additional alternatives (the Municipal and Water Quality alternatives). The alternatives were not intended to try to direct the Board's decision or to speculate on what that decision may be.

The following statements represent commenters' opinions, and DNRC is not offering responses.

340. **Comment:** I [Rich Day] support the instream flow requests of DFWP, DHES, and BLM.

341. **Comment:** I oppose BUREC's project for taking water from the Missouri River to the Milk River drainage.

342. **Comment:** I [J. Ramirez] oppose any action that would decrease my opportunities to divert and use more water for hay production.

343. **Comment:** Irrigation and municipalities should receive priority over DFWP's instream flow requests.

344. **Comment:** The request by DFWP for instream flow reservations for fish, wildlife, and recreation is unreasonable and should be disallowed.

345. **Comment:** Putting into place instream flow reservations that could be used by well-meaning but misinformed environmentalists would lead to a statewide environmental disaster. If it works, don't fix it.

346. **Comment:** Our headwater streams are so overappropriated with 97 percent controlled by irrigators that it doesn't make sense to continue adding new projects to a water rights system that is not working. The cost to the taxpayers is too high on the Consumptive Use Alternative and the Combination Alternative. The No Action Alternative allows a broken system to continue forever.

347. **Comment:** Through the reservation process, we have the opportunity to slow the decline of our aquatic resources and perhaps begin to turn the corner on developing a rational policy on the management of our flowing water systems. Unless you take significant conservation action now, this Department and this Board will be remembered as the

bureaucratic tandem that dealt a final death blow to Montana's irreplaceable rivers and streams.

348. **Comment:** The Pondera County Canal and Reservoir Company objects to the City of Conrad's application for a water reservation from Lake Francis.

349. **Comment:** We [Pat Simmons and Dick Krawiec] oppose the issuance of reservations to irrigators: Gallatin County Conservation District and Jefferson Valley Conservation District; and municipalities: City of Bozeman, City of Three Forks, and City of Belgrade. We are in favor of reservations of instream flows by the Department of Fish, Wildlife and Parks, the Department of Health and Environmental Sciences, and the U.S. Bureau of Land Management.

350. **Comment:** The Madison River arsenic levels and the low water flows of the Jefferson and Gallatin rivers do not justify more water diverted for irrigation.

351. **Comment:** We [Pat Simmons and Dick Krawiec] are very pleased that the three public agencies applied for instream flows on various streams throughout Montana. They shouldn't have to do this, but it should be an inalienable right for fish to have a place to live, because the public owns the water, and the Constitution of Montana requires that we protect our resources. But since you have decided they have to apply, we wholeheartedly support their reservations above all of the other requests.

352. **Comment:** We [City of Great Falls] agree that municipalities should be given first priority. The high benefit-to-cost ratios for municipalities presented in the draft EIS justifies this rating.

353. **Comment:** Agriculture is important, but it must not be allowed to destroy or adversely affect our public basic living natural resources.

354. **Comment:** DHES's request to reserve one-half of the average annual flow of the Missouri River to maintain water quality would unrealistically affect any future water uses in this basin.

355. **Comment:** It seems to us [Walter A. and Louise Steingruber] that more fingers in the pie, when already there are too many claims for the available water, will only aggravate the situation.

356. **Comment:** We [Hill County Conservation District] feel that some of the water requested by DFW could be put to more multi-purpose uses.

357. **Comment:** We [Hill County Conservation District] would like to give our support to the farmer and ranchers who are applying for these water reservations in our area through their local conservatio districts. Agriculture is a large part of our loca economy, and we hope to promote its survival.

358. **Comment:** During the first 100 or years or s of Montana's allocation of its water, only offstream o impounded water had legal protection. Water remaining in a stream was seen as valueless. B enacting the Water Use Act of 1973, Montana finall recognized instream water as a beneficial use. I authorizing water reservations (modified wate rights) for streamflow, the act legally acknowledge that Montana's instream waters provided an economic benefit to its citizens.

Today, that benefit is far greater than it was 2 years ago. It has since been quantified, at least i part, to Montana's residents and visitors in terms o land values, environmental health, water quality wildlife, and visual or psychic pleasure. We [Trou Unlimited, Madison-Gallatin Chapter] submit tha protection of instream flow by means of water reservations is not only highly justified, but long overdu

359. **Comment:** We [Trout Unlimited, Madison Gallatin Chapter] urge the Board to grant water reservations to the 18 municipalities that have applie for them.

360. **Comment:** By granting the instream reservations in the upper Missouri basin that DFWP, DHES and BLM have applied for, the Board will neithe increase instream flows nor diminish existing withdrawals for the state's important agricultural industry. These reservations would merely "stop the bleeding," so to speak, and help perpetuate the very significant benefits that living rivers and streams provide at current flow levels. The very late priority dat of reservations, their 10-year review, and their potential revocability absolutely guarantee that the cannot threaten the health and viability of Montan agriculture.

361. **Comment:** We [Medicine River Canoe Club basically support the requests by municipalitie However, we feel that all municipalities should firs seek more efficient methods of water distributio

and use and should encourage conservation by their residents so that any increased water consumption is truly needed for population growth and/or support of commercial and industrial demands.

362. **Comment:** We [Ben C. and Faye F. Holland] feel that the instream flow requests should be denied until the existing water rights adjudication process is complete, and that reservants should not have a standing to object to any non-consumptive uses, i.e., headgate replacements, changes in the places of diversions, storage projects, or temporary water right transfers.

363. **Comment:** DFWP's, DHES's, and BLM's requested instream flow reservations should be denied. It is in the public interest that all of Montana's water be reserved for future consumptive uses. Reservations for consumptive uses will ensure that Montana is in a better position to protect this water in the future interstate water adjudication process.

364. **Comment:** If the Board should grant a reservation for DFWP, the reservation should not become effective until the present adjudication process is completed.

365. **Comment:** One of the crucial elements of the Board's decision will be whether proposed projects are in the public interest. Maintenance of water quality is an important element of any sane public policy and is therefore in the public interest. Anything that exacerbates the existing violation of water quality standards, such as the arsenic standard, should not be allowed.

366. **Comment:** We [Wicks Ranch Corporation] fully agree that the water should not be overallocated. New water projects, be they irrigation, recreational, or industrial, should be limited to prevent drying up of streamflow.

367. **Comment:** Throughout Chapter Six, references are made to consumptive use projects that, if implemented, would reduce the flows in some streams to zero because those streams already are subject to extremely low flows. In our [DFWP] opinion, streamflows should not be allowed to be reduced any further in these low flow situations, and projects that would further reduce current low flows should not be approved.

368. **Comment:** Municipalities requesting water reservations should plan carefully by avoiding wasteful practices associated with lawns, golf courses, private swimming pools, vehicle washing, and other imprudent practices. Private wells dewatering aquifers for private and municipal uses must be strictly regulated by stringent state permitting and restrictions.

369. **Comment:** In the headwaters subbasin, water quality, streamflows, and land uses should remain about the same as now if the No Action Alternative is adopted because the frost-free season (approximately 40 days) prohibits any change in the crops, native grass for hay and pasture, only being raised.

370. **Comment:** The No Action Alternative is not acceptable because we [Medicine River Canoe Club] really do need to plan for the future and address some of our water problems now.

371. **Comment:** Neither the Consumptive Use Alternative nor the Combination Use Alternative is acceptable because of further impairment of water quality and exacerbation of dewatering problems.

372. **Comment:** Teton County Conservation District supports the Combination Alternative. It is our feeling that this alternative provides the best combination of future economic development while maintaining the quality of the water resource.

373. **Comment:** My [Bernard J. Harkness] comments will be confined to the headwaters subbasin, particularly the Red Rock and Beaverhead drainage—specifically Big Sheep Creek, Cabin Creek, Deadman Creek, Indian Creek, Nicholia Creek, and Simpson Creek in Big Sheep basin near Dell.

I believe that on these streams and the Big Sheep drainage that the No Action Alternative would be the best for the Board to pursue at the present time and deny all reservation applications.

374. **Comment:** Montana has been hailed as having world-class trout fisheries, and the annual influx of tourists and tourist dollars to the state attests to the value of our river resource. Unfortunately, it is becoming very clear to residents and tourists alike that our stressed river systems are not what they used to be, and they are deteriorating each year. The reason is the lack of water due to agricultural withdrawals that have displayed little or no sensitivity to our aquatic resources.

375. **Comment:** In reference to pages 22-32, "Montana Department of Fish, Wildlife and Parks Application," the Northern Region [U.S. Forest Service] supports the purpose of DFWP's application and recommends a favorable response by the Board on its [DFWP's] application. Many of the streams included in the application have their headwaters in national forests, and the reservation in part will protect fish and wildlife habitat in national forests. However, DFWP has been constrained by administrative rule (§ 85-2-316(6)) to 50 percent of the average annua flow of record on gauged streams. On gauged stream within National Forest boundaries, 50 percent of th average annual flow may not be sufficient to meet th needs for management or protection of National Fo est resources.

376. **Comment:** The EIS drafters obviously have strong bias against irrigation in favor of quality fishing.

CHANGES TO THE DRAFT EIS

In the following section, changes are made to the draft EIS in response to public comments. Comment pointing out incorrect statements in the draft EIS are followed by an excerpt from the draft EIS showing th corrections. Incorrect language has been crossed out, and new language is shaded.

377. **Comment**: Please refer to page 2 of the draft EIS, "Agencies with Additional Permitting Authority." W [the U.S. Forest Service] feel that this section, as well as the actual reservation document, needs to pu the potential applicants for reservations and the public on notice that the reservation of water approve by the Board conveys no implied consent by other permitting agencies or landowners. We suggest tha a disclaimer be added to this paragraph to make this perfectly clear.

The fact that an entity holds a water reservation does not guarantee that other regulatory agencie will grant the necessary permits for actual water development, nor does it give the water reservatio holder an advantageous position relative to the management of other competing natural and publi resources.

Response:

AGENCIES WITH ADDITIONAL PERMITTING AUTHORITY

If the Board grants reservations, other agencies may have additional regulatory jurisdiction over project development. These agencies are listed in Table 1-1.

By granting water reservations, the Board does not and cannot grant additional implied rights or privileges to the holder of a water reservation including land occupancy or rights of way over lands of others. Holders of water reservations must apply for and receive necessary permits from all applicable permitting authorities prior to exercising a water reservation.

378. **Comment**: On page 7, under "Water Leasing for Instream Flows," the four-year pilot program mentione in the paragraph is out of date. The pilot program is now for 10 years.

Response:

WATER LEASING FOR INSTREAM FLOWS

The 1989 legislature authorized DFWP to lease existing water rights for instream flows (§85-2-436, MCA) as part of a study program. The purpose of the legislation is to examine the feasibility of leasing existing water rights to maintain and enhance streamflow for fisheries. This ~~four-~~ten-year pilot program allows DFWP to lease water from willing water right holders.

379. **Comment**: The Sand Coulee project (LM-10) should not be in the draft EIS.

Response: The Lower Musselshell Conservation District withdrew LM-10 from the reservation process. Project JV-56 was also withdrawn, and Table 3-1 has been revised to reflect these exclusions.

Table 3-1. Conservation district reservation requests

Project Number	Point of Diversion			Peak Flow (cfs)	Annual Diversion (af)	Water Source	Project Acres
	TWN	RGE	SEC				
Jefferson Valley							
JV-17	T5N	R3W	29	1.87	129	Well	170
JV-18	T5N	R3W	33	1.10	76	Well	100
JV-25	T1S	R5W	32	0.53	59	Jefferson River	35
JV-55	T1N	R3W	10	1.86	192	Jefferson River	85
~~JV-56~~	~~T1N~~	~~R2W~~	~~21~~	~~1.21~~	~~136~~	~~Jefferson River~~	~~80~~
JV-63	T4N	R2W	29	0.82	99	Well	50
JV-80	T3N	R2W	19	0.96	67	Well	80
JV-81	T3N	R2W	31	1.31	159	Well	80
JV-95	T1N	R5W	14	14.43	1,749	Jefferson River	440
JV-201	T2S	R6W	23	80.30	11,022	Jefferson River	4,175
JV-202	T1S	R5W	14	88.90	12,177	Jefferson River	4,950
JV-203	T1N	R2W	26	35.80	5,313	Jefferson River	1,765
JV-204	T2S	R6W	23	7.42	703	Jefferson River	405
							~~12,415~~ 12,335
Lower Musselshell							
~~LM-10~~	~~T19N~~	~~R29E~~	~~28~~	~~100~~	~~11,200~~	~~Musselshell River, Sand Creek~~	~~—~~
LM-20	T8N	R26E	18	90	8,150	Groundwater, Musselshell River	—

380. **Comment**: In Table 3-1 (pp. 16-17), project GL-221 appears to be located in T34N, not T4N. Project LCI-10 appears to be located in R3W, not R2W. Other errors may occur in the table, as we only verified those locations near National Forest boundaries.

Response:

Table 3-1. Conservation district reservation requests

Project Number	Point of Diversion			Peak Flow (cfs)	Annual Diversion (af)	Water Source	Project Acres
	TWN	RGE	SEC				
Glacier County							
GL-11	T34N	R8W	32	3.72	472	Cut Bank Creek	277
GL-201	T30N	R9W	21	3.35	220	Whitetail Creek	86
GL-221	~~T4N~~ T34N	R7W	22	4.37	579	Cut Bank Creek	340
							703
Lewis and Clark County							
LC-11	T10N	R4W	13	0.60	80	UT Ten Mile Creek	30
LC-131	T20N	R6W	2	1.03	151	Elk Creek	60
LC-210	T15N	R3W	21	1.25	148	Missouri River	62
LC-251	T20N	R6W	25	1.82	281	Smith Creek	130.7
LCI-10	T12N	~~R2W~~ R3W	11	1.22	185	Upper Holter Lake	81.1
LCI-20	T17N	R5W	25	2.51	355	Dearborn River	173.1
							536.9

381. **Comment**: On page 22, under "Determination of Amount," the discussion about the variation of the wetted perimeter method developed by Tennant is not correct. Tennant did not use a wetted perimeter method to derive instream flow recommendations. Rather, he used a percentage of the mean annual flow from gauging stations to make his flow recommendations. This sentence should be changed.

Response:

DETERMINATION OF AMOUNT

DFWP used several methods to determine the amount of its instream flow requests. A thorough discussion of these methods is presented in DFWP's application. Gauge data were available for some streams, and flows were estimated in others. The Wetted Perimeter Inflection Point Method was used to determine most reservation requests. Several other methods were used in situations where the wetted perimeter method could not be used or where better methods were applicable. A ~~variation of the wetted perimeter~~ fixed percentage method that was developed ~~by Tennant (1976)~~ from the results of the wetted perimeter method was used to derive instream flow requests for 27 high quality stream segments. In segments of 17 high quality spring creeks, the lowest average monthly flow or "base flow" was requested. For seven other stream segments in the Madison and Gallatin watersheds, all remaining unappropriated water was requested. The relationship of stream flows to populations of aquatic organisms was used to determine the instream requests in a few other stream reaches. DFWP's methods are explained in more detail in Appendix B.

382. **Comment**: On page 24, Table 3-2, under Jefferson and Boulder River Drainages, the reach descriptio for North Willow Creek should read Hollow Top Lake to mouth.

Response:

Table 3-2. DFWP instream flow requests

JEFFERSON AND BOULDER RIVER DRAINAGES

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTE (cfs)	(af/yr
Boulder River #1	West and South forks to High Ore Creek	Jan 1 - Dec 31	20	14,47
Boulder River #2	High Ore Creek to Cold Spring	Jan 1 - Dec 31	24	17,37
Boulder River #3	Cold Spring to mouth	Jan 1 - Dec 31	47	34,02
Halfway Creek	Headwaters to canyon	Jan 1 - Dec 31	1.9	1,37
Hells Canyon Creek	Headwaters to mouth	Jan 1 - Dec 31	3.6	2,60
Jefferson River	Headwaters to Madison River	Jan 1 - Dec 31	1,100	796,36
Little Boulder River	Moose Creek to mouth	Jan 1 - Dec 31	7	5,06
North Willow Creek	Hollow ~~Trap~~ Top Lake to mouth	Jan 1 - Dec 31	7	5,06

383. **Comment**: On page 26, Table 3-2, under Dearborn River Drainage, Sheep Creek is not a tributary to th Dearborn. It should be moved to the section called upper Missouri River and Tributaries. Under Smit River #1, the reach description should be North and South Forks to Sheep Creek.

Response:

Table 3-2. DFWP instream flow requests

Upper Missouri River and Tributaries (continued)

STREAM	REACH DESCRIPTION	DATES REQUESTED	(cfs)	AMOUNT REQUESTED (af)	(af/yr
Sevenmile Creek	Greenhorn Creek and Skelly Gulch to mouth	Jan 1 - Dec 31	1.0	724	72
Sheep Creek	Headwaters of South Fork to mouth	Jan 1 - Dec 31	22	15,927	15,92
Silver Creek	Helena Valley Irrigation Canal to mouth	May 1 - Nov 30	13.0	5,518	
		Dec 1 - Apr 30	5.4	1,617	7,13
Sixteenmile Creek	Billy Creek to mouth	Jan 1 - Dec 31	20	14,479	14,47
Spokane Creek	Helena Valley Irr. Canal to mouth	May 1 - Nov 30	4.0	1,698	
		Dec 1 - Apr 30	3.0	898	2,59

DEARBORN RIVER DRAINAGE

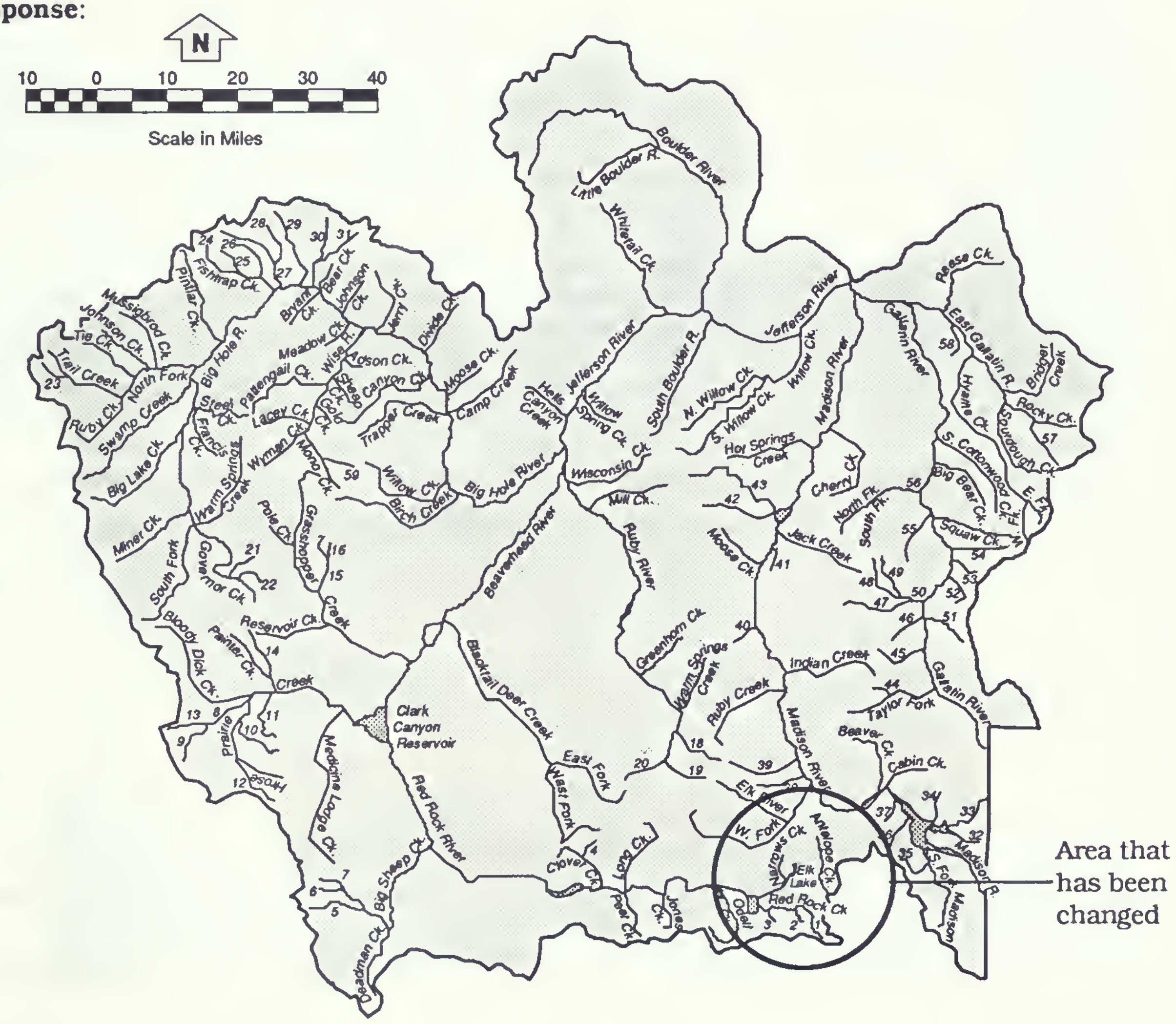
STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED (cfs)	(af)	(af/yr)
Dearborn River	Headwaters to mouth	Jan 1 - Dec 31	110	79,636	79,636
Flat Creek	Headwaters to mouth	Jan 1 - Dec 31	7.5	5,430	5,430
MF Dearborn River	Headwaters to mouth	Jan 1 - Dec 31	9.5	6,878	6,878
~~Sheep Creek~~	~~Headwaters of South Fork to mouth~~	~~Jan 1 - Dec 31~~	~~22~~	~~15,927~~	~~15,927~~
SF Dearborn River	Headwaters to mouth	Jan 1 - Dec 31	11.5	8,326	8,326

SMITH RIVER DRAINAGE

STREAM	REACH DESCRIPTION	DATES REQUESTED	AMOUNT REQUESTED (cfs)	(af)	(af/yr)
Big Birch Creek	Headwaters to mouth	Jan 1 - Dec 31	11	7,964	7,964
Eagle Creek	Headwaters to mouth	Jan 1 - Dec 31	2.5	1,810	1,810
Hound Creek	EF Hound Creek and Middle Creek to mouth	Jan 1 - Dec 31	35	25,339	25,339
Newlan Creek	Headwaters to mouth	Jan 1 - Dec 31	3.8	2,751	2,751
NF Deep Creek	Headwaters to rock cascades	Jan 1 - Dec 31	1.0	724	724
NF Smith River	Headwaters to mouth	Jan 1 - Dec 31	9	6,516	6,516
Rock Creek	Headwaters to mouth	Jan 1 - Dec 31	11	7,964	7,964
Sheep Creek	Headwaters to mouth	Jan 1 - Dec 31	35	25,339	25,339
Smith River #1	North and South Forks to Sheep Creek	Jan 1 - Dec 31	90	65,157	65,157

384. **Comment**: On page 29, Map 3-6, Narrows Creek in the Upper Red Rock drainage is mislocated. It should be shown to enter Elk Lake.

Response: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Scale in Miles
Boulder River
Little Boulder R.
Whitetail Ck.
Jefferson River
South Boulder R.
Willow Ck.
Madison River
Gallatin River
Reese Ck.
East Gallatin R.
Bridger Creek
Rocky Ck.
Hyalite Ck.
Sourdough Ck.
S. Cottonwood Ck.
Big Bear Ck.
Squaw Ck.
Gallatin River
Taylor Fork
Beaver Ck.
Cabin Ck.
S. Fork Madison
Madison R.
Mussigbrod Ck.
Johnson Ck.
Tie Ck.
Trail Creek
Ruby Ck.
North Fork
Swamp Creek
Big Lake Ck.
Fishtrap Ck.
Pintlar Ck.
Big Hole R.
Bryant Ck.
Bear Ck.
Johnson Ck.
Jerry Ck.
Divide Ck.
Meadow Ck.
Wise R.
Adson Ck.
Moose Ck.
Steel Creek
Pattengail Ck.
Canyon Ck.
Trapper Creek
Camp Creek
Francis Ck.
Lacey Ck.
Wyman Ck.
Mono Ck.
Warm Springs Creek
Willow Ck.
Birch Creek
Big Hole River
Hells Canyon Creek
Willow Spring Ck.
Wisconsin Ck.
Mill Ck.
Ruby River
N. Willow Ck.
S. Willow Ck.
Hot Springs Creek
Cherry Ck.
North Fk.
South Fk.
Moose Ck.
Jack Creek
Miner Ck.
South Fork
Governor Ck.
Pole Ck.
Grasshopper Creek
Bloody Dick Ck.
Painter Ck.
Reservoir Ck.
Creek
Beaverhead River
Blacktail Deer Creek
Greenhorn Ck.
Warm Springs Creek
Ruby Creek
Indian Creek
Madison River
Prairie
Horse
Medicine Lodge Ck.
Clark Canyon Reservoir
Red Rock River
Big Sheep Ck.
Deadman Ck.
East Fork
West Fork
Clover Ck.
Long Ck.
Peet Ck.
Jones
Elk River
W. Fork
Narrows Ck.
Elk Lake
Antelope Ck.
Red Rock Ck.
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Area that has been changed

385. **Comment**: On page 43, under "Flow Records," the USGS reference should be USGS 1989b. In that same paragraph, the reference to 341 measuring sites should be 321 sites.

Response:

FLOW RECORDS

To help provide a common basis for assessing flow conditions in streams throughout the basin, the USGS, in cooperation with DFWP, estimated the average monthly streamflow records at ~~341~~ 321 sites for the 50-year period from 1937 to 1986. USGS then computed new average monthly means and 20th, 50th, 80th, and 90th percentile exceedance flows for each site. The results are published in the Water Resources Investigations Report 89-4082 (USGS ~~1989~~ 1989b) and are used extensively in this draft EIS (Appendix D) and in many of the reservation applications.

386. **Comment**: On page 46, Table 4-2, the stream reach for the Beaverhead River should read Clark Canyon Dam to Mouth. Big Sheep Creek and Long Creek (under the Beaverhead River) belong under the Red Rock River and should be eliminated from the Beaverhead River section. Also, under Big Hole River, the following streams should be added: Pintlar Creek, Swamp Creek, Trail Creek, North Fork Big Hole River and Governor Creek.

Response:

Table 4-2. Headwaters Subbasin— low-flow problem areas

Stream/tributary	Stream reaches where low flow occurs	Cause of low flows
Beaverhead River	~~East Bench Diversion~~ Clark Canyon Dam to Mouth	~~Reservoir,~~ Irrigation
Poindexter Slough	Portions of slough	Irrigation
Spring Creek	Portions of creek	Irrigation
Rattlesnake Creek	Portions of creek	Irrigation
~~Big Sheep Creek~~	~~Cabin and Nicholia creeks to mouth~~	~~Irrigation~~
Blacktail Deer Creek	Middle Fork and West Fork to county road	Irrigation
Browns Canyon Creek	Portions of creek	Irrigation
Grasshopper Creek	Blue Creek to mouth	Irrigation
Horse Prairie Creek	Headwaters to mouth	Irrigation
~~Long Creek~~	~~Jones Creek to mouth~~	~~Irrigation~~
Medicine Lodge Creek	Bear Canyon to mouth	Irrigation
Big Hole River	Portions of river	Irrigation
Birch Creek	Mule Creek to mouth	Irrigation
Deep Creek	Sevenmile Creek to mouth	Irrigation
Jerry Creek	Portions of creek	Irrigation
Moose Creek	Portions of creek	Irrigation
Wise River	Mono & Jacobsen creeks to mouth	Irrigation
Willow Creek	Portions of creek	Irrigation
Trapper Creek	Portions of creek	Irrigation
Camp Creek	Portions of creek	Irrigation
Steel Creek	Portions of creek	Irrigation
Moose Creek	Portions of creek	Irrigation
Pintlar Creek	Portions of creek	Irrigation
Swamp Creek	Portions of creek	Irrigation
Trail Creek	Portions of creek	Irrigation
North Fork Big Hole River	Portions of creek	Irrigation
Governor Creek	Portions of creek	Irrigation

Stream/tributary	Stream reaches where low flow occurs	Cause of low flows
Red Rock River	Lima Dam to Clark Canyon Reservoir	Reservoir, Irrigation
Big Sheep Creek	~~Portions of creek~~ Canyon to mouth	Irrigation
Odell Creek	Portions of creek	Irrigation
Sage Creek	Portions of creek	Irrigation
Long Creek	~~Portions of creek~~Jones Creek to mouth	Irrigation
Little Sheep Creek	Portions of creek	Irrigation

387. **Comment**: On page 46, Table 4-2, Baker Creek, South Cottonwood Creek, Camp Creek, and Big Bear Creek are not tributaries to the East Gallatin River. They are tributaries to the Gallatin River.

Response:

Table 4-2. Headwaters Subbasin— low-flow problem areas

Stream/tributary	Stream reaches where low flow occurs	Cause of low flows
East Gallatin River	Near confluence with Gallatin River	Irrigation
Thompson Springs Creek	Portions of creek	Irrigation
Ross Creek	Portions of creek	Natural
Reese Creek	Portions of creek	Irrigation
Dry Creek	Portions of creek	Irrigation
~~Baker Creek~~	~~Lane bridge to mouth~~	~~Irrigation~~
Bridger Creek	Headwaters to mouth	Irrigation
Hyalite Creek	Middle Creek ditch to I-90 bridge	Irrigation
~~South Cottonwood Creek~~	~~Jim Creek to Hart Ditch headgate~~	~~Irrigation~~
Sourdough Creek	Portions of creek	Irrigation
Smith Creek	Portions of creek	Irrigation
~~Camp Creek~~	~~Portions of creek~~	~~Irrigation~~
~~Big Bear Creek~~	~~Below forest boundary~~	~~Irrigation~~
Gallatin River	~~West Fork and East Gallatin River to mouth~~ Shedd's Bridge to mouth	Irrigation
Baker Creek	Lane Bridge to mouth	Irrigation
South Cottonwood Creek	Jim Creek to Hart Ditch headgate	Irrigation
Camp Creek	Portions of creek	Irrigation
Big Bear Creek	Below forest boundary	Irrigation

388. **Comment**: On page 46, Table 4-2, under Gallatin River, the stream reach where low flow occurs should be changed from that shown to Shedd's Bridge to mouth.

Response: See the response to comment 387.

389. **Comment**: On page 47, Table 4-2, under Madison River, change stream reach to Hebgen Dam to Quake Lake.

Response:

Table 4-2. Headwaters Subbasin— low-flow problem areas

Stream/tributary	Stream reaches where low flow occurs	Cause of low flows
Madison River	Hebgen Dam to ~~West Fork~~ Quake Lake	Reservoir

390. **Comment**: On page 49, the draft EIS states:

> Both dams [Hauser and Holter] are generally operated as run-of-the-river facilities; they have little storage, and water runs out as fast as it flows in. However, Holter Reservoir has enough storage to significantly alter streamflows on a daily to weekly basis.

This statement needs clarification. The text states that the two reservoirs together have "little storag but on the other hand, Holter Reservoir alone can "significantly alter" the streamflows. This paragrap should be reworded. Also on page 49, it probably should be added to the first paragraph that flood contr operations at Canyon Ferry are done in cooperation with the Corps of Engineers.

Response:

The operation of Canyon Ferry Dam, a multi-purpose facility used to store water for irrigation, hydropower, flood control, and recreation, has the biggest influence on the Missouri River's monthly flow. Operations are aimed at storing high spring flows to fill the reservoir by the end of June and then releasing water gradually over the summer, fall, and winter to reach maximum drawdown by the end of February. BUREC plans releases in cooperation with MPC and DFWP to maximize benefits in hydropower production and recreation. Figure 4-4 presents average monthly inflow and outflow for Canyon Ferry Lake to illustrate the dam's regulating effects on main-stem river flows. Flood control operations at Canyon Ferry Reservoir are done in cooperation with the U.S. Army Corps of Engineers.

MPC's Hauser and Holter dams, located just downstream from Canyon Ferry, also alter main-stem streamflows, but to a much lesser degree than Canyon Ferry. Both dams are generally operated as run-of-the-river facilities; ~~they have little storage, and water runs out as fast~~ that is, water usually is released from the reservoir at about the same rate as it flows in. However, Holter Reservoir has enough storage to significantly alter streamflows on a daily to weekly basis. Neither facility is large enough to alter monthly streamflow patterns to any significant degree. MPC operates five run-of-the-river dams near Great Falls—Rainbow, Black Eagle, Ryan, Cochran, and Morony—for hydropower generation. As with the Hauser and Holter facilities, these dams can be used to alter flows on a daily basis, but not on a monthly scale.

391. **Comment**: On page 50, Table 4-4, under Missouri River, the Missouri River itself from its headwate at Three Forks to Canyon Ferry Reservoir should be added to the list as a stream with a dewateri problem due to irrigation.

Response:

Table 4-4. Upper Missouri Subbasin—low flow problem areas

Stream-Tributary	Stream Reaches	Cause
Missouri River ~~(Three Forks to Canyon Ferry)~~	Headwaters at Three Forks to Canyon Ferry Reservoir	Irrigation
Avalanche Creek	Cooney Gulch to Canyon Ferry Reservoir	Irrigation, Natural
Beaver Creek	Headwaters to Canyon Ferry Reservoir	Irrigation
Confederate Gulch	Debauch Gulch to mouth	Irrigation, Natural

392. **Comment**: On page 51, under "Marias/Teton Subbasin," it should be added to the last paragraph that flood control operations at Tiber are performed in cooperation with the Corps of Engineers.

Response:

MARIAS/TETON SUBBASIN

Though many small irrigation dams are located on the headwater tributaries, BUREC's Tiber Reservoir on the Marias River has the greatest impact on monthly streamflow patterns in the subbasin. Tiber Reservoir, originally designed to supply water to the proposed Lower Marias Irrigation Unit and potentially to support new hydropower development, is currently used for flood control, recreation, and streamflow maintenance, with a small portion of the water used for irrigation and municipal supplies. Operation of this facility is guided by the intention to fill the reservoir by the end of June and draw the reservoir down by the end of February (BUREC 1986). Flood control operations at Tiber Reservoir are done in cooperation with the U.S. Army Corps of Engineers. The average monthly inflow and outflow hydrographs for Tiber are presented in Figure 4-5.

393. **Comment**: On page 53, Table 4-7, the sections showing flows for the Missouri River at Virgelle and the Judith River near Winifred are missing the 20th percentile and historical header data. Please add this information.

Response: The figures have been moved to align with the proper columns.

Table 4-7. Monthly average and percentile exceedance streamflows (cfs) for selected USGS gauges in the Middle Missouri Subbasin

USGS GAUGE	NAME		MONTHLY FLOWS												
			OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG.
1095	Missouri River at Virgelle	Average	6310	6550	6380	6270	6640	7570	9140	14400	19700	10300	6210	5880	8779
		20th %	7650	7560	7370	7710	8370	9120	12100	18800	26200	14300	8130	7050	11197
		50th %	6140	6390	6450	5950	6650	7170	8510	13400	18000	9990	5800	5430	8323
		80th %	4890	5360	5180	4870	5180	5660	6210	9920	11700	5620	4310	4250	6096
1135	Judith River near Winifred	Average	407	417	424	434	483	537	519	538	548	548	469	440	480
		20th %	554	581	594	603	641	707	725	722	724	674	669	638	653
		50th %	419	446	473	485	527	587	495	533	553	555	480	473	502
		80th %	243	243	246	243	251	306	294	358	303	316	247	243	274

394. **Comment**: On page 54, under "Legal Water Availability in the Missouri Basin," the statement that all applicants claim that water is physically available for their reservations does not apply to the DFWP reservations. We never have claimed that water is physically or legally available all the time to meet our reservation requests. The amount of water available for instream flows will depend on the priority date of the reservation in relating to other water rights and the water available to satisfy those rights.

Response:

LEGAL WATER AVAILABILITY IN THE MISSOURI BASIN

For the Board to grant a water reservation, it must find that the reservation will not adversely affect senior water rights. ~~Although all applicants claim that water is physically available for their reservations, this~~ This water may already be appropriated under existing water claims, permits, or federal reserved water rights that have a priority date before July 1, 1985.

395. **Comment**: On page 55, under "Status of Water Right Permits," last paragraph, in addition to th discussion in that paragraph, a statement should be included as to how many applications have bee received for new water use permits since 1987. This would clarify the confusion in the last sentence o the paragraph in which the phrase "the 75 remaining applications . . ." is used with no reference to th original number of applications.

Response:

Since 1987, DNRC has received 145 permit applications for water in the Missouri basin upstream of MPC's Great Falls facilities. Of these, DNRC has issued 70 provisional permits in the basin with 45 of these for water above Canyon Ferry Reservoir. Ten of the 70 permits, which are intended for irrigation use, resulted in the purchase of temporary water service contracts from BUREC after objections were received from MPC. Sixty permits were for nonconsumptive uses such as mining, power generation, and fisheries and wildlife purposes and were not objected to by MPC. The 75 remaining applications for provisional water use permits are pending because objections have been filed by MPC and the applicants have chosen not to acquire water-service contracts.

396. **Comment**: On page 57, we suggest the following changes to the last half of the first paragraph.

Response: The suggested changes have been made as follows:

In April 1989, DHES informed BUREC that the issuance of a water service contract for a consumptive use would violate existing water quality standards for arsenic. Because of this, BUREC plans to prepare an EIS on marketing water for consumptive uses from Canyon Ferry Reservoir over the next few years. Until the EIS is completed, BUREC is informing each potential applicant that ~~it must pay the cost(s) for preparing~~ an environmental review may be required to determine ~~any~~ the effect of the project ~~may have~~ on arsenic concentrations in the Missouri River. BUREC has estimated that the cost for each assessment would probably exceed $10,000. Since April 1989, no consumptive use permit or long-term water service contract has been issued.

397. **Comment**: On page 60, fourth paragraph, the second half of the third sentence is not correct and shoul be changed.

Response: The suggested changes have been made as follows:

BUREC has claimed water rights for power generation (direct flow and storage rights), irrigation, flood control, municipal, fish and wildlife, recreation, storage for future use or sale, and river regulation for power generation at Canyon Ferry and MPC's downstream power plants. BUREC's claimed water right for hydropower generation is 6,390 cfs, which is based on 5,100 cfs from MPC's original 1898 Lake Sewell water right and an additional 1,290 cfs to meet the capacity of its hydropower turbines. Helena Valley Irrigation District has claimed an additional 800 cfs which runs through a separate penstock at Canyon Ferry: 420 cfs of this total ~~goes~~ is released through a pump turbine ~~to generate electricity to run the pump~~ that diverts 380 cfs to the Helena Valley Irrigation Project. It is quite common for flows through the Canyon Ferry turbines to exceed 6,000 cfs when water is available. In recent years (1985-1991), water has spilled over the spillway without generating electricity only once, and that was for a two-week period in 1986.

398. **Comment**: On page 62, Table 4-13, under West Gallatin River, the reach should be changed from Yellowstone Park to Shedd's Bridge. Also, the reach for Big Spring Creek should be changed from state fish hatchery to mouth. There also should be the following addition to Table 4-13: Missouri River, Holter Dam to mouth of Smith River, 1/1-12/31, 3,000 cfs.

Response:

Table 4-13. Summary of DFWP "Murphy rights" in the Missouri basin

STREAM	REACH	DATES	AMOUNT (cfs)
Madison River	Hebgen Dam to Quake Lake	4/1-7/31	50
		8/1-3/31	500
Madison River	Quake Lake to mouth of West Fork	1/1-12/31	500
Madison River	Mouth of West Fork to Ennis Lake	1/1-5/31	900
		6/1-7/15	1400
		7/16-12/31	1050
Madison River	Ennis Lake to mouth	1/1-5/31	1200
		6/1-6/30	1500
		7/1-7/15	1423
		7/16-12/31	1300
West Gallatin River	Yellowstone Park to ~~Gallatin Gateway~~ Shedd's Bridge	5/16-7/15	800
		7/16-5/15	400
Gallatin River	Mouth to junction with East Gallatin River	5/1-5/15	947
		5/16-5/31	1278
		6/1-6/15	1500
		6/16-6/30	1176
		7/1-8/31	850
		9/1-4/30	800
Missouri River	Toston Dam to Canyon Ferry Reservoir	1/1-1/31	1500
		2/1-5/15	3000
		5/16-6/30	4000
		7/1-7/15	3816
		7/16-9/14	1500
		9/15-12/31	3000
Smith River	Fort Logan Bridge to confluence of Sheep Creek	5/1-6/30	150
		7/1-4/30	90
Smith River	Confluence of Sheep Creek to Cascade-Meagher county line	4/1-4/30	140
		5/1-6/30	150
		7/1-8/31	140
		9/1-3/31	125
Smith River	Cascade-Meagher county line to confluence of Hound Creek	5/1-5/15	372
		5/16-6/15	400
		6/16-6/30	398
		7/1-4/30	150
Big Spring Creek	State Fish Hatchery to mouth ~~of Cottonwood Creek~~	1/1-12/31	110
Missouri River	Holter Dam to mouth of Smith River	1/1-12/31	3,000

Source: DNRC Water Rights Records; DFWP 1991

399. **Comment**: This comment concerns the reference in the draft EIS to the Montana Rivers Informatio System (MRIS). On Page 86, under "Fisheries and Aquatic Habitat," the second paragraph explains th origin of the data as the "Rivers Study Fisheries Database located at the Montana Natural Resource Information System . . . ." The Montana Rivers Study has been renamed the Montana Rivers Informatio System. The Natural Resource Information System (NRIS) disseminates the information contained i MRIS. The "fisheries database" is a portion of MRIS and is not a data set that stands alone. On page 86 the second paragraph under "Fisheries and Aquatic Habitat" should be changed.

Response:

FISHERIES AND AQUATIC HABITAT

Information presented in the following sections comes primarily from the fisheries portion of the Montana Rivers ~~Study Fisheries Database located at~~ Information System housed by the Montana Natural Resource~~s~~ Information System ~~(MNRIS) in~~ at the Montana State Library. Fisheries value class ratings, species composition, and relative abundance of fish were obtained from this source. DFWP's reservation application (DFWP 1989) was used to determine habitat conditions and additional information on species composition. Other information sources are cited in the text.

400. **Comment**: On page 86, under "Fisheries and Aquatic Habitat," 80 species of fish should be changed t 85 species.

Response:

FISHERIES AND AQUATIC HABITAT

Streams and rivers in the Missouri River basin support a diverse fish population. Of the ~~80~~ 85 species of fish found in Montana, about 55 are found in lakes and streams of the Missouri River basin above Fort Peck Dam. Between Morony Dam near Great Falls and Fort Peck Reservoir, the river makes a transition from a cold water fishery to a warm water fishery. The warm water fishery of the lower river contains the greatest diversity of fish with 39 species. In contrast, headwater tributaries often support only two to four fish species.

401. **Comment**: On page 88, under "Paddlefish," the state record paddlefish weighed 142.5 pounds.

Response:

PADDLEFISH

The paddlefish is another boneless fish native to the Missouri and Yellowstone rivers in Montana (Figure 4-14). The largest paddlefish on record in Montana weighed ~~131~~ 142.5 pounds (DFWP 1991), although they average 20 pounds and 50 inches in length (Brown 1971). During spring runoff, paddlefish migrate from Fort Peck Reservoir up the Missouri River presumably to spawn. Berg (DFWP 1989) identified nine such paddlefish concentration areas between Virgelle and Fort Peck Reservoir.

402. **Comment**: On page 89, under "Arctic Grayling," arctic grayling are known to reach lengths of 20 inches. Distribution of grayling in the Sun River now is limited to those found in the Sunny Slope Canal below Pishkun Reservoir. Grayling no longer are found in the Sun River or its tributaries. Grayling found in the Red Rock River may be drifters from the Red Rock Lakes area.

Response:

ARCTIC GRAYLING

The arctic grayling is a member of the trout family and native to Montana. Its large, colorful dorsal fin distinguishes it from other Montana trout. The arctic grayling is valued as a game fish, reaching lengths up to ~~14~~ 20 inches ~~in Montana~~. Food requirements of the arctic grayling are similar to other trout except that it rarely eats other fish.

The arctic grayling was native to two areas in the lower 48 states: Michigan, where it is now extinct, and in the Missouri River drainage above Great Falls, where it was once abundant. The original range of the stream-dwelling grayling has been greatly reduced and is now limited to the Big Hole River, possibly some of its tributaries, the Sunny Slope Canal below Pishkun Reservoir, and ~~the Sun, Red Rock, and~~ possibly the Madison ~~rivers~~ River and Odell Creek in Montana ~~(Brown 1971)~~. Arctic grayling also live in lakes but depend on flowing water for spawning. Lake-dwelling grayling are abundant and apparently secure in Montana and other western states (Clark et al. 1989). Although the cause of decline in stream-dwelling arctic grayling populations has not been identified, low streamflows, changes in land use, and the introduction of non-native species may be among the contributing factors (McMichael 1990).

403. **Comment**: On page 89, under "Westslope Cutthroat Trout," although Brown (1971) states that a westslope cutthroat trout can grow as large as 16 pounds, this may be somewhat misleading. A three- to four-pound maximum weight is more likely to occur.

Response:

WESTSLOPE CUTTHROAT TROUT

The westslope cutthroat trout is an important game fish in Montana. It ~~can grow as large as 16 pounds~~ grows to a three- to four-pound weight in Montana ~~where habitat conditions are favorable (Brown 1971)~~.

404. **Comment**: On page 89, under "Blue Sucker," the state record weight for a blue sucker is 11.5 pounds.

Response:

BLUE SUCKER

Though secure globally, the blue sucker is rare in Montana. It has been found in the Missouri River below Fort Benton, the Marias River, the lower Judith River, and the lower portion of the Yellowstone River. Specimens weighing 16 pounds have been reported elsewhere, but most in Montana weigh less than 7.7 pounds (Brown 1971). The state record weight for a blue sucker is 11.5 pounds (DFWP 1991). The blue sucker is not a game fish in Montana, though it is said to be highly prized as a food fish in some areas (Brown 1971).

405. **Comment**: On page 89, under "Headwaters Subbasin - Gallatin River Drainage," the number 25 should be changed to 24 streams.

Response:

HEADWATERS SUBBASIN

GALLATIN RIVER DRAINAGE

Reservations for instream use, consumptive use, or both have been requested on ~~25~~ 24 streams in the Gallatin River drainage. These streams support populations of trout and whitefish (Appendix G). Nongame species frequently found in these streams include longnose dace, mottled sculpin, and three species of suckers.

406. **Comment**: On page 90, under "Madison River Drainage," first paragraph, reservations have bee requested on 29 stream reaches rather than 26 reaches. Also in that paragraph, beginning with line only one stream supports arctic grayling.

Response:

MADISON RIVER DRAINAGE

Reservations are requested on 26 ~~stream reaches~~ streams in the Madison River drainage. Appendix G shows the relative abundance of fish found in this drainage and the fisheries value class rating for each stream. The Madison River drainage supports populations of rainbow, brown, brook, and a few cutthroat trout. Nine streams have mountain whitefish, and ~~four have~~ one has arctic grayling. Other nongame fish species found in the drainage include mottled sculpins in most streams, two species of dace, three sucker species, a few stonecats, and an occasional perch.

407. **Comment**: On page 90, under "Madison River Drainage," third paragraph, the first sentence should changed.

Response: This information updates material found in DFWP's application and has been changed follows.

~~Stream-dwelling~~ Arctic grayling are found year-round in ~~Standard Creek and~~ the Madison River. Lake-dwelling arctic grayling spawn in ~~Moore Creek~~ the Madison River and possibly Moore Creek and the South Fork of Meadow Creek. Genetically pure westslope cutthroat trout are believed to occur in Standard Creek, but laboratory analysis has not been performed to verify their genetic purity.

408. **Comment**: On page 91, under "Jefferson and Boulder River Drainages," first paragraph, 11 strea reaches should be changed to 13 stream reaches.

Response:

JEFFERSON AND BOULDER RIVER DRAINAGES

Reservations have been requested on ~~11~~ 13 stream reaches in the Jefferson and Boulder River drainages. Appendix G shows that trout are common or abundant in most of these streams. Nongame fish found in these streams include mottled sculpins, three species of suckers, and three members of the minnow family. Halfway Creek is the only stream in this drainage known to support native, genetically pure westslope cutthroat trout.

409. **Comment**: On page 91, under "Jefferson and Boulder River Drainages," third paragraph, the followi sentence should be added to the paragraph.

Response:

JEFFERSON AND BOULDER RIVER DRAINAGES

Beginning in 1986 and continuing each year for three years, Trout Unlimited and DFWP planted a wild strain of rainbow trout in Willow Spring Creek. It is hoped that the young fish will move down into the Jefferson River to mature and eventually return to the creek to spawn. In 1991, rainbow trout returned to Willow Spring Creek, indicating that the stocking efforts are proving successful (DFWP 1991).

410. **Comment:** On page 92, Table 4-25, footnote "a" should be deleted.

Response:

Table 4-25. Jefferson River tributaries providing spawning and rearing habitat for game fish

Lake or stream where spawning run originates	Tributary stream	Fish species spawning in tributary streams
Jefferson River	Hells Canyon Creek	Rainbow trout
	Willow Spring Creek[a]	Rainbow trout
	Boulder River (Reach 3)	Brown trout
Willow Creek Reservoir	South Willow Creek	Rainbow trout, brown trout
	North Willow Creek	Rainbow trout, brown trout
	Willow Creek	Rainbow trout, brown trout

~~[a] DFWP is trying to establish a rainbow trout spawning run in this stream. It is too early to determine the success of this effort.~~

411. **Comment:** On page 92, under "Big Hole River Drainage," first paragraph, brown trout should be added to the sentence beginning with line 5. In the second paragraph, line 6, Terry Creek should read Jerry Creek. However, Deep Creek and Jerry Creek should be eliminated from that listing because Deep Creek provides only winter habitat for grayling, and Jerry Creek does not support a grayling population at all. Also, in the last sentence of that paragraph, Deep and Jerry creeks do not provide spawning habitat for grayling.

Response:

BIG HOLE RIVER DRAINAGE

Instream reservations are sought on 46 streams in the Big Hole River drainage. Appendix G lists fish species, their relative abundance, and the fisheries value class rating for each stream in this drainage. In general, the Big Hole River and its tributaries support abundant populations of brook, brown, rainbow, and cutthroat trout. Burbot, also known as ling, are present in many streams. Pure strain westslope cutthroat trout, a species of special concern, have been reported in Delano Creek. Arctic grayling, another species of special concern, are present in several streams.

The Big Hole River drainage supports a renowned fishery and is highly valued for its population of native stream-dwelling arctic grayling. Spawning by arctic grayling has been documented in the following streams in the Big Hole River drainage: Big Hole River and Big Lake, Rock, Steel, ~~Deep, Terry,~~ and Swamp creeks. Swamp, Big Lake, and Rock creeks provide spawning areas for grayling that live in the Big Hole River (Spence 1990). ~~Besides providing spawning habitat for grayling,~~ Deep and ~~Terry~~ Jerry creeks both provide spawning habitat for rainbow trout from the Big Hole River.

412. **Comment**: On page 92, under "Ruby River Drainage," first paragraph, the first sentence should read 1 stream segments rather than 10 stream segments.

Response:

RUBY RIVER DRAINAGE

Instream reservations are sought on ~~10~~ 11 stream segments in the Ruby River drainage. Appendix G identifies the fish species present in these streams, their relative abundance, and the fisheries value class rating for each stream in this drainage. Trout and whitefish are the primary game fish found in this drainage. Nongame species include stonecats, long-nose dace, mottled sculpins, three species of suckers, and carp. Westslope cutthroat trout possibly are found in ~~Coal and~~ the North Fork of Greenhorn ~~creeks~~ Creek, but laboratory analysis has not been performed to determine their genetic purity.

413. **Comment**: On page 92, under "Ruby River Drainage," westslope cutthroat trout are found in Coal Cree and the North Fork of Greenhorn Creek.

Response: DNRC contacted the genetics lab at the University of Montana to determine whether geneti testing had been completed (Sage 1991). Genetic testing by electrophoresis is used to determine whethe westslope cutthroat trout have hybridized with rainbow or Yellowstone cutthroat trout. Records at th university indicate that trout in Coal Creek are hybrids. The university has no records to indicate th genetic purity of westslope cutthroat trout in the North Fork of Greenhorn Creek. Page G-7 has bee corrected (see response to comment 412 and following page).

414. **Comment**: On page 93, under "Red Rock and Beaverhead Drainage," first paragraph, 35 stream reache should read 37 stream reaches. In the second paragraph, we are not aware of any stream-dwelling arcti grayling that reside in the Beaverhead River below the East Bench Diversion Dam. Grayling may exis in the reach of the Red Rock River upstream from Lima Reservoir, but these fish may be drifters from th Red Rock Lakes area.

Response:

RED ROCK AND BEAVERHEAD DRAINAGE

Appendix G identifies fish species present in the Red Rock and Beaverhead river drainages, their relative abundance, and the fisheries value class rating for each of the ~~35~~ 37 stream reaches where reservations are requested. Trout, whitefish, and arctic grayling are the most common game fish in this drainage, though a few burbot also are found. Nongame species include mottled sculpins, longnose dace, stonecats, four species of suckers, and carp. Two species of special concern are found in this drainage: westslope cutthroat trout and arctic grayling.

Most arctic grayling in the drainage live in Red Rock lakes and spawn in their tributaries. Stream-dwelling arctic grayling are thought to exist in Odell Creek, a tributary to Red Rock lakes~~, and in the reach of the Beaverhead River below East Bench diversion dam~~.

415. **Comment**: On page 93, under "Upper Missouri Subbasin, Missouri River - Three Forks to Holter Dam the first and second sentences are incorrect and should be changed.

Headwaters subbasin (continued)

Key to Symbols: 1=outstanding 2=high value 3=substantial 4=moderate 5=limited 6=insufficient information to classify stream

A=abundant; C=common; P=present; PE=presence expected but not confirmed; U=uncommon; R=rare

		FAMILY	Sturgeon		Paddlefish	Mooneye	Trout								Pike	Minnow																	Sucker									Catfish			Codfish	Sunfish							Perch				Drum	Sculpin	Stickleback
Stream	Fisheries Resource Value Class	COMMON NAME	Pallid sturgeon	Shovelnose sturgeon	Paddlefish	Goldeye	Mountain whitefish	Kokanee	Cutthroat trout	Rainbow/cutthroat hybrid	Rainbow trout	Brown trout	Brook trout	Arctic grayling	Northern pike	Carp	Minnow	N. Redbelly x finescale dace	Utah chub	Flathead chub	Sturgeon chub	Lake chub	Sicklefin chub	Emerald shiner	Redside shiner	Sand shiner	Brassy minnow	Plains minnow	Plains/silvery minnow	Silvery minnow	Fathead minnow	Longnose dace	River carpsucker	Blue sucker	Smallmouth buffalo	Bigmouth buffalo	Shorthead redhorse	Longnose sucker	White sucker	Largescale sucker	Mountain sucker	Black bullhead	Channel catfish	Stonecat	Burbot	Green sunfish	Pumpkinseed	Bluegill	Smallmouth bass	Largemouth bass	White crappie	Black crappie	Yellow perch	Sauger	Walleye	Iowa darter	Freshwater drum	Mottled sculpin	Brook stickleback
RUBY RIVER DRAINAGE																																																											
Coal Creek	6								~~P~~	P																																																
Cottonwood Creek																																																										
4km Above Mouth-Mouth	4								R		R																																														U	
4.8km Above Mouth-4.0km Above Mouth	4								R																																																U	
EF Ruby River	4								U	U	C																					PE							PE																			P	
MF Ruby River	6								P	P	P																																														P	
Mill Creek																																																										
National Forest-BN RR Bridge	4										U		C																																													
Leggat Creek-National Forest	4										R		C																																													
NF of Greenhorn Creek	1								P				C																																													
Ruby River #1																																																										
National Forest-Ruby River Reservoir	3						U				A	U	R																			P							C	P	P																	P	
Warm Springs Creek-National Forest	3						C				C	C																				P							U																		P	
Three Forks Ruby River-Warm Springs Creek	4						C			C		R																				P																											
Coal Creek-Three Forks Ruby River	4								U	C	R																					PE							PE																			PE	
Ruby River #2	2						C				R	A				P																P							P	P																		P	
Warm Springs Creek																																																										
Still Creek-Mouth	3						R		U		C	C																				A						A			U			A															
Road-Buckskin Creek	4								A		U	C																																															
Headwaters-Road	3								C																																																	
WF Ruby River	4								U	U	R		P																			PE							PE																			PE	
Wisconsin Creek	5								P				P																																													P	
RED ROCK-BEAVERHEAD DRAINAGE																																																										
Bear Creek	2								C				A																																												C	
Beaverhead River #1																																																										
Clark Canyon Dam-Grasshopper Creek	1						A				C	A	U			R																U						C	U		U				U													A	
Beaverhead River #2																																																										
Anderson Lane-Mouth	3						U				U	C	R			U																A						C	U		R				U													A	
Stodden Ditch-Anderson Lane	3						U				U	C	R			U																A						C	U		R				U													A	
Big Sheep Creek																																																										
Irrigation Diversion-Mouth	4						PE			PE	PE	PE																										PE	PE																				
Shearing Pen Gulch-Irrigation Diversion	3						U			U	A	C																										C	C																				
Source-Shearing Pen Gulch	2										A	C																				A																										A	
Black Canyon Creek	6												P																																												P	
Blacktail Deer Creek																																																										
East Bench Canal-Mouth	3						P				U	C																				P							C	C																			
Above E. Bench Canal-East Bench Canal	5										PE		PE																																													
W Fk. Blacktail Creek-2.4km Above E. Bench Canal	3						A				U		C																			A																										A	
Bloody Dick Creek																																																										
National Forest-Mouth	3						U				C		A																																												PE	
Park Creek-National Forest	3						C				A		A																																												A	
Browns Canyon Creek	6								P																																																	
Cabin Creek	2								C																																																	
Corral Creek	2								U				A	U																								P																				A	
Deadman Creek	3								P	A	P																																														A	

Response:

Upper Missouri Subbasin

Missouri River - Three Forks to Holter Dam

~~Reservations~~ Instream reservations are sought ~~on 11 tributaries, Holter Reservoir, Canyon Ferry Reservoir, and the Missouri River~~ for two reaches of the Missouri River above Holter Dam and for 18 tributaries of Holter Reservoir, Hauser Reservoir, Canyon Ferry Reservoir, and the upper Missouri River. The predominant game fish in the Missouri River above Canyon Ferry are still whitefish and trout~~, but walleye~~. Walleye and kokanee salmon have been introduced into Holter and Hauser reservoirs~~, and kokanee~~. Kokanee salmon are found in ~~Canyon Ferry,~~ Holter~~,~~ and Hauser reservoirs ~~(Appendix G)~~. Perch also are found in all three reservoirs. Smallmouth bass are being planted in Lake Helena, which is connected to Hauser Reservoir.

416. **Comment**: On page 93, Table 4-26, the following should be added to Red Rock Lakes: Hell Roarin Creek - cutthroat trout, possibly arctic grayling, and Corral Creek - possibly arctic grayling.

Response: Regarding the presence of arctic grayling in Hell Roaring Creek, DFWP's application (DFW 1989) states:

> No arctic grayling were captured during the 1975 surveys. It appears that this stream, although historically used by both resident and adfluvial grayling, is no longer suitable for this species. Barriers are apparently not the problem since Hell Roaring Creek is accessible to spawning cutthroat trout residing in the lake.

For Corral Creek, DFWP's application states:

> Corral Creek appears to no longer support a resident population of stream-dwelling (fluvial) grayling. There are indications that grayling from Upper Red Rock Lake still enter the creek each year to spawn. However, the reproductive contribution of Corral Creek is unknown.

However, Oswald (1991) confirmed the presence of runs of arctic grayling from Upper Red Rock Lake both Hell Roaring and Corral creeks last spring. The creeks also are used for rearing, and young graylin move downstream to the lake in response to current in the stream.

Cutthroat trout and arctic grayling have been added to Hell Roaring Creek, and arctic grayling have bee added to Corral Creek.

Table 4-26. Red Rock and Beaverhead drainage tributary streams providing spawning and rearing habitat for game fish

Lake or stream where spawning run originates	Tributary stream	Fish species spawning in tributary streams
Red Rock Lakes	Red Rock Creek	Arctic grayling, cutthroat trout, rainbow/ cutthroat hybrid tro
	Tom Creek	Arctic grayling
	Odell Creek	Arctic grayling
	Hell Roaring Creek	Arctic grayling, cutthroat trout
	Corral Creek	Arctic grayling

417. **Comment**: On page 94, first paragraph, line 10, the sentence is incorrect and should be changed.

Response:

Most rainbow trout caught from Canyon Ferry are stocked, but about 5 percent are produced naturally from spawning in tributaries to the reservoir (Lere 1990). About 95 percent of the rainbow trout caught in gill nets set by DFWP in Hauser Reservoir are stocked (Lere 1990), with the remaining 5 percent originating from spawning in the tributaries. Brown trout reach trophy size in the three reservoirs. Brown trout are not stocked and depend on spawning in tributaries. Kokanee salmon have been stocked in the past, but the present populations in Hauser ~~Reservoir~~ and Holter reservoirs depend~~s~~ on natural reproduction. A large number of kokanee also spawn in the Missouri River immediately below Canyon Ferry and Hauser dams during the fall. Table 4-27 indicates the tributary streams used for spawning by fish from the reservoirs.

418. **Comment:** On page 94, Table 4-27, Beaver Creek under Hauser Reservoir should be listed under Holter Reservoir instead.

Response:

Table 4-27. Missouri River tributary streams providing spawning and rearing habitat for game fish in Canyon Ferry, Hauser, and Holter reservoirs

Lake or stream where spawning run originates	Tributary stream	Fish species spawning in tributary streams
Hauser Reservoir	Spokane Creek	Brown trout, kokanee salmon, mountain whitefish
	McGuire Creek	Brown trout, kokanee salmon
	Trout Creek	Rainbow trout, brown trout, kokanee salmon
	Prickly Pear Creek	Rainbow trout, brown trout
	Silver Creek	Rainbow trout, brown trout, kokanee salmon
	~~Beaver Creek~~	~~Rainbow trout, brown trout~~
Holter Reservoir	Cottonwood Creek	Rainbow trout
	Willow Creek	Rainbow trout, brown trout
	Missouri River	Brown trout, rainbow trout, kokanee salmon
	Beaver Creek	Rainbow trout, brown trout

419. **Comment:** On page 95, under "Smith River Drainage," first paragraph, the 11 stream reaches stated may be in error. DFWP alone has filed for 13 stream reaches in the Smith River drainage.

Response:

SMITH RIVER DRAINAGE

Applications have been filed for consumptive or instream water reservations on 11 ~~stream reaches~~ streams in the Smith River drainage. Appendix G indicates streams that support populations of trout, whitefish, and a few burbot. Nongame species include longnose dace, mottled sculpins, three species of suckers, and an occasional carp and stonecat.

420. **Comment:** On page 95, under "Smith River Drainage," third paragraph, Tenderfoot Creek is the only stream where documented spawning has occurred to date. Other tributary streams may serve this purpose.

Response:

Tenderfoot Creek is the only tributary stream ~~used for~~ where spawning by trout from the Smith River has been documented. Walsh (1990) reports that both rainbow and brown trout from the Smith River spawn in the lower portion of Tenderfoot Creek.

421. **Comment:** On page 95, Table 4-28, white suckers and longnose suckers are not gamefish and shoul be eliminated from the table. Also, the following streams should be added to Table 4-28: Dearborn rive - rainbow trout; South Fork Dearborn River - rainbow trout; Middle Fork Dearborn River - rainbow trout Sheep Creek - rainbow trout, brown trout, mountain whitefish.

Response: Table 4-28 has been revised to include the additional streams in the Dearborn drainag Although the two sucker species listed in the table are not game fish, they do spawn in Little Prickly Pea Creek.

Table 4-28. Missouri River tributary streams providing spawning and rearing habitat for ~~game~~ fish between Holter Dam and Great Falls

Lake or stream where spawning run originates	Tributary stream	Fish species spawning in tributary streams
Missouri River	Little Prickly Pear Creek	Rainbow trout, brown trout, white suckers, longnose suckers mountain whitefish
	Lyons Creek	Rainbow trout, brown trout
	Wolf Creek	Rainbow trout
	Wegner Creek	Rainbow trout
	Stickney Creek	Rainbow trout
	Dearborn River	Rainbow trout
	South Fork Dearborn River	Rainbow trout
	Middle Fork Dearborn River	Rainbow trout
	Sheep Creek	Rainbow trout, brown trout, mountain whitefish

422. **Comment:** On page 96, under "Belt Creek Drainage," second paragraph, only the lower five miles of Bel Creek above Otter Creek are stocked with rainbow trout.

Response:

BELT CREEK DRAINAGE

The lower portion of Belt Creek is used for spawning by limited numbers of ~~rainbow trout,~~ brown trout, mountain whitefish, and sauger from the Missouri River. The lower five miles of Belt Creek above Otter Creek are stocked with rainbow trout. The 13-mile stretch of Belt Creek above Big Otter Creek does not maintain an adequate self-sustaining trout population ~~and is stocked with rainbow trout~~. This reach has severe low flows and substantial fishing pressure.

423. **Comment:** On page 98, under "Musselshell River Drainage," the 13 stream reaches stated in the firs sentence may be in error. DFWP alone has filed on 16 stream reaches in the Musselshell drainage.

Response:

MUSSELSHELL RIVER DRAINAGE

Reservations are sought on 13 ~~stream reaches~~ streams in the Musselshell River drainage. Above the Deadmans Basin diversion, the drainage supports fish characteristic of cold water streams; trout and mountain whitefish predominate. A transition from a cold water to a warm water fishery takes place between the Deadmans Basin diversion and the Musselshell diversion about 80 miles to the east. This portion of the river supports sparse populations of brown trout, smallmouth bass, and channel catfish. Below the Musselshell diversion, the river supports warm water species, including sauger, channel catfish, smallmouth bass, black bullhead, northern pike, and walleye. Appendix G identifies the fish species found in streams in the Musselshell drainage where reservations are requested, the relative abundance of fish in each stream, and the fisheries value class of each stream.

424. **Comment**: In reviewing the discussion of angler use beginning on page 111 of the draft EIS under "Headwaters Subbasin," we noticed discrepancies in the angler use numbers used throughout the section. Our corrections that we believe necessary are listed below.

a. Rivers and streams in 1985 had 355,090 angler days of use, not 349,820.

b. Angler days statewide in 1985 were 2,443,438, not 1,193,000. Statewide stream use in 1985 was 1,324,277 angler days; 1,322,566 of these days can be assigned to specific drainages.

c. Angler use is licensed angling pressure. This pressure does not include juveniles, which account for 10 to 25 percent of the pressure, or any pressure on Indian reservations or national parks.

d. Percentage of pressure in headwaters basin is 14.5 percent if based on total statewide angling pressure, or 26.8 percent if based on total statewide stream/river angling pressure.

e. On page 111, under "Headwaters Subbasin," second paragraph, DFWP has available fishing pressure information for 1988-89 that could be used to supplement the angler use data presented on this and succeeding pages, including Table 4-47.

f. On page 112, Map 4-7, the subbasin percentages are wrong based on statewide stream use that can be assigned to specific drainages.

g. On page 112, Map 4-7, some of the percentages shown are not the same percentages shown in "DFWP 1989," which probably refers to our [DFWP] reservation application, pages 1 through 35.

h. On page 112, Table 4-47 should be revised based on coding errors when doing survey (i.e., Clark Canyon and Clark Canyon Reservoir are the same, and Hyalite Lake and Hyalite Reservoir should be added since Hyalite Lake receives very little pressure).

i. The sources of data for Tables 4-47 (page 112), 4-49 (page 118), 4-51 (page 121), and 4-53 (page 123) are shown as DFWP 1989. The reference probably should read McFarland 1989.

j. On page 115, angler use (total) for the upper Missouri subbasin for streams/rivers only is 205,743 angler days or 15.6 percent of total use.

Response: The following changes have been made:

a,b,c,d. HEADWATERS SUBBASIN

DFWP estimated annual licensed angler use on Montana waters from 1982 to 1986. This use does not include national parks, Indian reservations, or use by juveniles. Rivers and streams in the Headwaters Subbasin during 1985 had a total of ~~349,820~~ 355,090 angler days of use, representing ~~29.3~~ 26.8 percent of the total ~~1,193,000~~ 1,322,566 angler days on rivers and streams in various subbasins statewide. An angler day is one fisherman fishing one body of water for any length of time on one day. Map 4-7 shows that the Headwaters Subbasin receives the most angler use of any subbasin in Montana. Map 4-8 shows angler use, selected recreation sites, and estimated nonangler use on selected streams in the Headwaters Subbasin. Table 4-47 lists angler use on selected reservoirs in this subbasin.

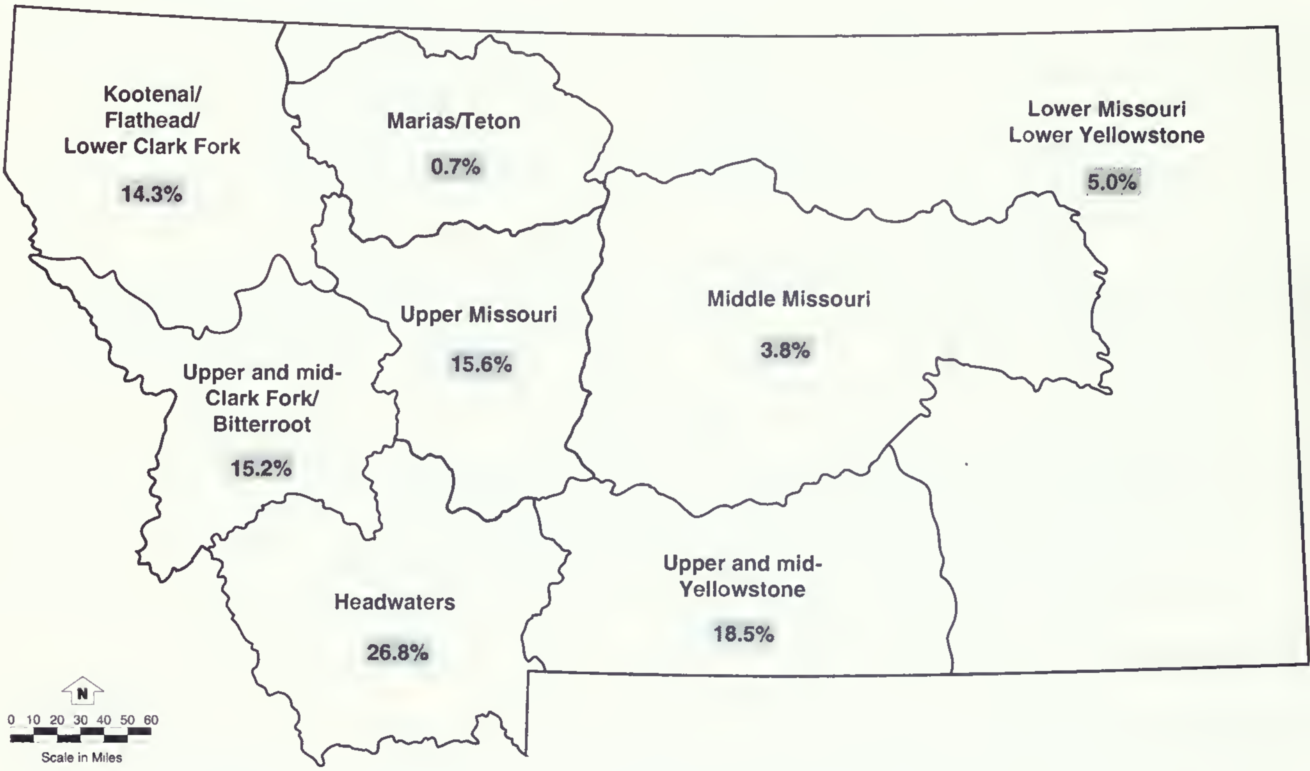
e. Angler use information for 1988-89 has been incorporated into the revised Appendix H: Recreatio Information for Rivers and Streams with Reservation Requests (see pages 153 through 162).

f,g. Map 4-7 has been revised (see below).

h,i. Table 4-47 has been revised (see page 163). The source has also been revised to read "McFarlan 1989" for Tables 4-49, 4-51, and 4-53.

j. Angler use in the Upper Missouri Subbasin is significant, totaling ~~184,731~~ 205,743 days during 1985. This represents ~~15.5~~ 15.6 percent of the total ~~1,193,000 days of statewide use~~ 1,322,566 angler days on rivers and streams in various subbasins statewide (see Map 4-7).

Map 4-7. Fishing use of Montana river subbasins


Kootenai/
Flathead/
Lower Clark Fork
14.3%
Marias/Teton
0.7%
Lower Missouri
Lower Yellowstone
5.0%
Upper Missouri
15.6%
Middle Missouri
3.8%
Upper and mid-
Clark Fork/
Bitterroot
15.2%
Headwaters
26.8%
Upper and mid-
Yellowstone
18.5%
N
0 10 20 30 40 50 60
Scale in Miles

Notes:

Numbers shown are the percentage of total statewide fishing days occurring in each river subbasin determined during the 1985 DFWP fisheries survey.

Upper Missouri subbasin includes the main stem and tributaries from the Sun to the Marias.

Percentages may not total 100 due to rounding.

~~Source:~~ Adapted from DFWP 1989

Revised Table H-1. Recreation information for rivers and streams with reservation requests

BIG HOLE RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
American Creek	93	48	-	(n=2)	U	-	-	-	-	-	-	-	-
Bear Creek	138	-	-	(n=1)	U	-	-	-	-	-	-	-	-
Big Hole River (Headwaters-Pintlar Creek)	8,902	7,372	153	(n=3)									
Continental Divide-NF Big Hole River					2	F/SR	6	S	P	P	P	H/M	0
Big Hole River (Pintlar Creek-Divide Creek)	23,502	9,905	500	(n=4)									
NF Big Hole River-Divide Bridge					1	MR	6	S	P	P	P	H	4
Big Hole River (Divide Creek-Mouth)	21,005	22,394	412	(n=4)									
Divide Bridge-Beaverhead River					1	SR/MR	6	P	P	P	P	H	8
Big Lake Creek	105	109	-	(n=1)									
Twin Lakes-Big Hole River					2	NB	0	-	-	P	S	M	1
Birch Creek	137	215	-	(n=1)									
Anchor Lake-Forest Service Boundary					2	NB	0	-	-	S	P	H	2
Bryant Creek		-		(n=0)									
Headwaters-Big Hole River					3	NB	0	-	-	P	S	L	0
California Creek	648	195	-	(n=3)	U	-	-	-	-	-	-	-	-
Camp Creek	180	60	-	(n=2)									
Headwaters-Big Hole River					3	NB	0	-	-	P	P	M	0
Canyon Creek	278	-	-	(n=2)									
Headwaters-Mouth					1	NB	0	-	-	P	P	H	2
Corral Creek	268	-	-	(n=1)	-	-	-	-	-	-	-	-	-
Deep Creek	418	164	-	(n=3)									
Headwaters-French Creek					1	NB	0	-	-	P	S	L	1
Delano Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Divide Creek	634	39	-	(n=3)	U	-	-	-	-	-	-	-	-
Fishtrap Creek	452	60	-	(n=2)									
MF Big Hole River					U	NB	0	-	-	-	-	-	0
Francis Creek		-		(n=0)									
Headwaters-Steel Creek					3	NB	0	-	-	S	-	L	0
French Creek	239	-	-	(n=2)	U	-	-	-	-	-	-	-	-
Governor Creek	103	36	-	(n=3)									
Headwaters-Big Hole River					3	NB	0	-	-	-	-	L	0
Jacobsen Creek		-		(n=0)	-	-	-	-	-	-	-	-	-
Jerry Creek	655	169	-	(n=3)									
Headwaters-Mouth					3	NB	0	-	-	P	S	L	0

Column 1A = Angler days/year (average of 1982-1986 values)[a]
Column 1B = Angler days/year (1989 value)
Column 2 = Angler days/year/river mile (1982 - 1986)
Column 3 = Number of years in which fishing pressure has been measured (1982 - 1986)
Column 4 = Recreational value—1 = outstanding; 2 = substantial; 3 = moderate; 4 = limited; U = unclassified
Column 5 = Water character—F = flat; SR = small rapids; MR = moderate rapids; LR = large rapids; NB = not boated
Column 6 = Months of year boatable
Column 7 = Boating/floating[b]
Column 8 = Boat fishing[b]
Column 9 = Shore fishing[b]
Column 10 = Shoreline activities[b]
Column 11 = Nonangler use estimate—H = high; M = moderate; L = low
Column 12 = Number of developed sites

[a] For this EIS, high angler use = more than 10,000 angler days per year for a given stream or river segment; moderate angler use = 1,000-10,000 angler days per year; low angler use = less than 1,000 angler days per year.

[b] For columns 7 through 10: P = primary activity, one of the main reasons for visiting this stream or river segment; S = secondary activity, an activity or use occurring on this stream, but not one of the most important uses

Sources: Columns 1A, 2, and 3: McFarland 1989.
Column 1B: DFWP 1991.
Columns 4 through 12: ~~Natural Resource~~ Recreation portion of the Montana Rivers Information System 1989. Comprehensive recreation information is not available for all streams.

Big Hole River drainage (continued)	1A	1B	2	3	4	5	6	7	8	9	10	11
Johnson Creek	262	109	-	(n=3)								
Headwaters-Mouth					3	NB	0	-	-	P	S	M
Joseph Creek	273	-	-	(n=1)								
Chief Joseph Pass-Trail Creek					3	NB	0	-	-	P	S	L
LaMarche Creek	499	390	-	(n=3)								
Wilderness Boundary-Big Hole River					1	NB	0	-	-	P	P	M
Miner Creek	866	36	-	(n=4)								
Upper Miner Lake-Big Hole River					1	F	3	S	S	P	P	M
Moose Creek	137	147	-	(n=1)								
Humbug Spires-Big Hole River					3	NB	0	-	-	P	P	M
Mussigbrod Creek	232	-	-	(n=2)								
Wilderness Boundary-Big Hole River					2	NB	0	-	-	P	P	L
NF Big Hole River	1,571	85	-	(n=4)								
Battlefield-Big Hole River					U	NB	0	-	-	-	-	U
Oregon Creek		-		(n=0)								
Pattengail Creek	344	60	-	(n=2)								
Elbow Lake-Wise River					1	F	4	S	S	P	S	M
Pintlar Creek	722	219	-	(n=3)								
Wilderness Boundary-Big Hole River					2	NB	0	-	-	P	S	M
Rock Creek	701	364	-	(n=4)								
Continental Divide-Swamp Area					3	NB	0	-	-	S	S	L
Ruby Creek	394	526	-	(n=4)								
Headwaters-Trail Creek					3	NB	0	-	-	P	S	M
Sevenmile Creek	752	-	-	(n=1)	-	-	-	-	-	-	-	-
Seymour Creek	188	152	-	(n=1)								
Wilderness Boundary-Big Hole River					2	NB	0	-	-	P	S	H
Sixmile Creek		-		(n=0)								
SF Big Hole River		-		(n=0)								
Steel Creek	826	39	-	(n=2)								
Moose Meadow-Big Hole River					3	NB	0	-	-	P	P	M
Sullivan Creek		-		(n=0)								
Swamp Creek		52		(n=0)								
Yank Swamp-Big Hole River					3	NB	0	-	-	P	-	L
Tenmile Creek	376	60	-	(n=1)								
Trail Creek	538	696	-	(n=3)								
Gibbons Pass-NF Big Hole River					3	F	4	S	S	P	S	M
Trapper Creek	137	60	-	(n=1)								
Headwaters-Forest Service Boundary					2	NB	0	-	-	P	S	H
Twelvemile Creek	240	-	-	(n=2)								
Warm Springs Creek	568	-	-	(n=2)								
West Pioneers-Big Hole River					3	NB	0	-	-	P	S	L
Willow Creek	389	-	-	(n=1)								
Tendoy Lake-BLM Boundary					3	NB	0	-	-	S	P	M
Wise River	3,001	3,038	107	(n=4)								
Mono Creek-Big Hole River					2	SR	2	S	-	P	P	H
Wyman Creek	235	-	-	(n=2)								
Headwaters-Wise River					1	NB	0	-	-	P	S	H

GALLATIN RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Baker Creek	787	235	-	(n=3)	U	-	-	-	-	-	-	-
Ben Hart Spring Creek	100	-	-	(n=1)	U	-	-	-	-	-	-	-
Big Bear Creek		-		(n=0)	U	-	-	-	-	-	-	-
Bridger Creek	1,546	115	-	(n=4)	U	-	-	-	-	-	-	-
Cache Creek		39		(n=0)	U	-	-	-	-	-	-	-
EF Hyalite Creek		-		(n=0)								
Heather Lake-Hyalite Reservoir					1	NB	0	-	-	P	P	H

Gallatin River drainage (continued)	1A	1B	2	3	4	5	6	7	8	9	10	11	12
East Gallatin River (Headwaters-Mouth)	7,629	2,751	-	(n=4)									
Rocky/Bozeman Creek-Springhill Bridge					3	NB	0	S	-	P	-	M	-
~~East Gallatin River~~													
Springhill Bridge-Gallatin River					2	SR	6	S	S	P	-	L	0
Gallatin River (Spanish Cr.-Yellowstone Park)	14,619	28,147	357	(n=4)									
Yellowstone NP-WF Gallatin River					1	MR	4	P	P	P	S	H	2
Gallatin River (Spanish Cr.-EF Gallatin)	28,408	27,665	789	(n=4)									
WF Gallatin River-Greek Creek					1	MR	4	P	S	P	P	H	3
Greek Creek-Hwy. 191 Bridge					1	LR	4	P	-	P	S	H	2
Hwy. 191 Bridge-East Gallatin River					1	MR	4	P	P	P	P	H/M	4
Gallatin River (EF Gallatin-Mouth)	13,439	9,213	1,120	(n=4)									
EF Gallatin River-Missouri River					2	SR	7	S	S	P	S	H	1
Hell Roaring Creek	273	-	-	(n=1)									
Headwaters-Gallatin River					U	NB	0	-	-	-	-	-	0
Hyalite Creek (Mouth-Hyalite Reservoir)	2,800	849	-	(n=4)									
Hyalite Reservoir-Forest Service Boundary					2	NB	-	0	-	P	P	H	2
NF of the WF Gallatin River		-		(n=0)	U	-	-	-	-	-	-	-	-
Porcupine Creek	644	-	-	(n=1)									
Fortress Mountain-Gallatin River					2	NB	0	-	-	P	P	H	0
Reese Creek	20	39	-	(n=1)	U	-	-	-	-	-	-	-	-
Rocky Creek	638	990	-	(n=4)	U	-	-	-	-	-	-	-	-
Sourdough (Bozeman) Creek	90	155	-	(n=1)									
Headwaters-Forest Service Boundary					2	NB	0	-	-	P	P	H/M	0
Forest Service Boundary-E. Gallatin River					2	NB	0	-	-	P	S	H	1
South Cottonwood Creek	574	152	-	(n=1)									
Timber Butte-Forest Service Boundary					2	NB	0	-	-	P	P	M/L	0
SF Spanish Creek	182	-	-	(n=2)									
Spanish Lakes-Spanish Creek					U	NB	0	-	-	-	-	-	0
SF of the WF Gallatin River		-		(n=0)									
Headwaters-WF Gallatin River					3	NB	0	-	-	P	P	M	2
Spanish Creek		-		(n=0)									
Confluence NF &SF-Gallatin River					U	NB	0	-	-	-	-	-	0
Squaw Creek	367	505	-	(n=4)									
Divide Peak-Gallatin River					2	NB	0	-	-	P	P	M	2
Taylor Fork of the Gallatin River	763	1,045	-	(n=4)									
Wilderness Boundary-Gallatin River					2	NB	0	-	-	P	P	M	0
Thompson Spring Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
WF Gallatin River	433	-	-	(n=3)									
Headwaters-Gallatin River					2	NB	0	-	-	P	P	H	1
WF Hyalite Cr. (Hyalite Reservoir-Hyalite Lake)	177	48	-	(n=2)									
Hyalite Peak-Hyalite Reservoir					1	NB	0	-	-	P	P	H	1

JEFFERSON RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Boulder River (Headwaters-Mouth)	2,543	4,997	33	(n=4)									
Headwaters-Bison Creek					3	F	3	S	-	P	P	M	3
Bison Creek-Jefferson River					3	SR/MR	2	S	S	P	-	M	0
Halfway Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Hells Canyon Creek		55		(n=0)	U	-	-	-	-	-	-	-	-
Jefferson River	21,125	15,260	251	(n=4)									
Big Hole/Beaver-Missouri River					2	SR/MR	5	P	P	P	P	H	7
Little Boulder River	571	585	-	(n=4)	U	-	-	-	-	-	-	-	-
North Willow Creek	336	-	-	(n=2)									
Hollowtop Lake-Forest Service Boundary					3	NB	0			P	P	L	0
South Boulder River	295	680	-	(n=2)	U	-	-	-	-	-	-	-	-

Jellerson River Drainage (continued)	1A	1B	2	3	4	5	6	7	8	9	10	11
South Willow Creek	425	-	-	(n=3)								
Granite Lake-Forest Service Boundary					3	NB	0			P	S	H
Whitetail Creek	297	111	-	(n=2)	U	-	-	-	-	-	-	-
Willow Creek	2,042	1,414	-	(n=4)	U	-	-	-	-	-	-	-
Willow Spring Creek		-		(n=0)	U	-	-	-	-	-	-	-

MADISON RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Antelope Creek		-		(n=0)								
Saddle Mountain-Cliff Lake					3	NB	0	-	-	P	P	H
Beaver Creek	210	61	-	(n=3)	U	-	-	-	-	-	-	-
Black Sand Spring Creek		-		(n=0)	U	-	-	-	-	-	-	-
Blaine Spring Creek	297	150	-	(n=1)	U	-	-	-	-	-	-	-
Cabin Creek	68	-	-	(n=1)								
Headwaters-Quake Lake					U	NB	0	-	-	-	-	-
Cherry Creek	835	61	-	(n=4)	U	-	-	-	-	-	-	-
Cougar Creek	511	329	-	(n=1)	U	-	-	-	-	-	-	-
Duck Creek	1,504	448	-	(n=3)	U	-	-	-	-	-	-	-
Elk River		36		(n=0)	U	-	-	-	-	-	-	-
Grayling Creek	326	460	-	(n=2)	U	-	-	-	-	-	-	-
Hot Springs Creek	137	85	-	(n=1)								
Headwaters-Madison River					3	NB	0	-	-	P	S	L
Indian Creek	422	52	-	(n=2)								
Forest Service Boundary-Madison River					3	NB	0	-	-	P	S	L
Jack Creek	377	108	-	(n=3)								
Headwaters-Forest Service Boundary					2	NB	0	-	-	P	P	H
Madison R. (Yellowstone Pk-Hebgen Dam)	12,906	11,231	759	(n=4)	U	-	-	-	-	-	-	-
Madison River (Hebgen Dam-Ennis Lake)	40,636	64,406	589	(n=4)								
Hebgen Reservoir-Quake Lake					2	MR	4	S	P	S	S	H
Quake Lake-McAtee Bridge					1	SR/MR	6	S	P	P	P	H
McAtee Bridge-Ennis Lake					1	SR	6	S	P	P	P	H
Madison River (Ennis Lake-Mouth)	36,742	38,151	919	(n=4)								
Ennis Lake Dam-Hot Springs Creek					1	LR	9	P	-	P	P	H
Hot Springs Creek-Missouri River					1	SR	9	S	P	P	P	H
Moore Creek		-		(n=0)	U	-	-	-	-	-	-	-
North Meadow Creek	133	155	-	(n=3)								
Headwaters-Ennis Lake					3	NB	0	-	-	P	P	M
O'Dell Spring Creek	771	60	-	(n=3)	U	-	-	-	-	-	-	-
Red Canyon Creek		-		(n=0)								
Headwaters-Hebgen Lake					U	NB	0	-	-	-	-	-
Ruby Creek	683	93	-	(n=1)								
Headwaters-Madison River				3	NB	0	-	-	P	S	M	1
SF Madison River	2,600	203	-	(n=4)	U	-	-	-	-	-	-	-
Squaw Creek	100	-	-	(n=1)								
Wilderness Boundary-Madison River					3	NB	0	-	-	P	-	L
Standard Creek		-		(n=0)								
Black Butte-Madison River					3	NB	0	-	-	P	S	M
Trapper Creek		-		(n=0)								
Coffin Mountain-Hebgen Lake					3	NB	0	-	-	-	S	M
Watkins Creek		-		(n=0)								
Idaho Border-Hebgen Lake					1	NB	0	-	-	P	P	M
WF Madison River	1,154	1,162	-	(n=4)								
Headwaters-Madison River					2	NB	0	-	-	P	P	L

RED ROCK-BEAVERHEAD DRAINAGES

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Bear Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Beaverhead River (Headwaters-Mouth)	22,356	22,690	283	(n=4)									
Clark Canyon Dam-Dillon					1	SR/MR	7	P	P	P	S	H/M	3
Dillon-Big Hole River					1	F/SR	8	P	P	P	S	H/M	3
Big Sheep Creek	735	1,577	-	(n=4)									
Nicholia-Red Rock River					2	NB	0	-	-	P	P	H	0
Black Canyon Creek		-		(n=0)									
Headwaters-Horse Prairie Creek					3	NB	0	-	-	-	S	L	0
Blacktail Deer Creek	1,956	2,323	-	(n=4)									
Confluence MF & WF-Beaverhead River					3	F	1	-	-	P	S	M	0
Bloody Dick Creek	2,404	2,098	-	(n=3)									
Headwaters-Horse Prairie Creek					3	NB	0	-	-	P	P	H	1
Browns Canyon Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Cabin Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Corral Creek	268	-	-	(n=1)	U	-	-	-	-	-	-	-	-
Deadman Creek	435	-	-	(n=1)									
Headwaters-Big Sheep Creek					1	NB	0	-	-	P	P	L	0
EF Blacktail Deer Creek	194	88	-	(n=1)									
Two Meadows-Blacktail Deer Creek					3	NB	0	-	-	P	P	H/M	0
EF Clover Creek		-		(n=0)									
Headwaters-Clover Creek					3	NB	0	-	-	P	S	M/L	0
EF Dyce Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Frying Pan Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Grasshopper Creek	2,440	531	-	(n=4)									
Headwaters-Forest Boundary					1	NB	0	-	-	P	P	H	3
Forest Boundary-Bannack					1	NB	0	-	-	P	S	H	2
Bannack-Beaverhead River					3	SR	2	S	-	P	S	M/L	1
Hell Roaring Creek		-		(n=0)									
Headwaters-Red Rock Creek					3	NB	0	-	-	P	P	L	0
Horse Prairie Creek	105	61	-	(n=4)									
Headwaters-Clark Canyon Dam					3	NB	0	-	-	P	S	M	0
Indian Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Jones Creek		79		(n=0)	U	-	-	-	-	-	-	-	-
Long Creek	137	60	-	(n=1)									
Lone Butte-Red Rock River					3	NB	0	-	-	S	P	M	0
Medicine Lodge Creek	527	236	-	(n=4)									
Headwaters-Horse Prairie Creek					3	NB	0	-	-	P	S	M/L	0
Narrows Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Odell Creek	700	-	-	(n=1)									
Slide Mountain-Lower Red Rock Lake					U	NB	0	-	-	-	-	-	0
Peet Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Poindexter Slough	1,459	1,874	-	(n=4)	2	F	2	S	P	P	S	H/M	1
Rape Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Red Rock Creek	597	1,249	-	(n=3)									
Headwaters-Red Rock Refuge					2	F	3	P	-	P	P	M	0
Red Rock River (Lima Dam-Upper Red Rock Lake)	397	281	8	(n=2)									
Lower Red Rock Lake-Brundage Bridge					2	F	4	S	S	P	S	M	0
Brundage Bridge-Lima Reservoir					2	F/SR	4	S	S	P	S	M/L	0
Red Rock River (Lima Dam-Mouth)	2,928	1,575	51	(n=4)									
Lima Reservoir-Clark Canyon Reservoir					4	F/SR	7	P	P	P	S	L	1
Reservoir Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Shenon Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Simpson Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Tom Creek		57		(n=0)	U	-	-	-	-	-	-	-	-
Trapper Creek	137	60	-	(n=1)	U	-	-	-	-	-	-	-	-
WF Blacktail Deer Creek		36		(n=0)									
Headwaters-Blacktail Creek					3	NB	0	-	-	P	S	M	0
WF Dyce Creek		-		(n=0)	U	-	-	-	-	-	-	-	-

RUBY RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Coal Creek		59		(n=0)	U	-	-	-	-	-	-	-
Cottonwood Creek		-		(n=0)								
Geyer Creek-Ruby River					3	NB	0	-	-	P	P	H
EF Ruby River		-		(n=0)								
Gravelly Ridge-Ruby River					2	NB	0	-	-	P	S	M
MF Ruby River		-		(n=0)	U	-	-	-	-	-	-	-
Mill Creek	415	47	-	(n=1)								
Branham Lakes-Ruby River					2	NB	0	-	-	P	P	H
NF Greenhorn Creek		-		(n=0)	U	-	-	-	-	-	-	-
Ruby River (Headwaters-Ruby Reservoir)	1,040	813	19	(n=4)								
Headwaters-Ruby Reservoir					3	SR	2	S	-	P	P	H
Ruby River (Ruby Reservoir-Mouth)	5,725	10,395	119	(n=4)								
Ruby Reservoir-Beaverhead River					3	F/SR	5	S	S	P	S	M
Warm Springs Creek	429	-	-	(n=2)								
Romey Lake-Ruby River					2	NB	0	-	-	P	P	H
WF Ruby River		-		(n=0)								
Headwaters-Ruby River					2	NB	0	-	-	P	S	M
Wisconsin Creek		52		(n=0)								
Headwaters-Ruby River					3	NB	0	-	-	S	S	L

MISSOURI RIVER DRAINAGE-Three Forks to Holter Dam

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Avalanche Creek		-		(n=0)								
Thompson Creek-Canyon Ferry Lake					4	NB	0	-	-	P	S	L
Beaver Creek (above Canyon Ferry Dam)	1,288	-	-	(n=1)	U	-	-	-	-	-	-	-
Beaver Creek (below Canyon Ferry Dam)	925	2,035	-	(n=4)								
Porcupine Creek-Bear Gulch					3	NB	0	-	-	-	S	L
Bear Gulch-Missouri River					2	NB	0	-	-	P	S	M
Confederate Gulch	200	-	-	(n=1)	U	-	-	-	-	-	-	-
Cottonwood Creek		-		(n=0)	U	-	-	-	-	-	-	-
Crow Creek	1,252	181	-	(n=4)								
Tizer Creek-Radersburg					3	SR/MR	1	S	-	P	S	M
Radersburg-Missouri River					U	-	-	-	-	-	-	-
Deep Creek	602	317	-	(n=4)								
Skidway Campground-Ross Gulch					3	NB	0	-	-	P	S	M
Dry Creek	2,717	166	-	(n=4)	U	-	-	-	-	-	-	-
Duck Creek	150	-	-	(n=1)	U	-	-	-	-	-	-	-
McGuire Creek		-		(n=0)	U	-	-	-	-	-	-	-
Missouri River (Headwtrs-Canyon Ferry Dam)	11,162	10,729	167	(n=4)								
Headwaters State Park-Canyon Ferry Lake					2	F	9	P	P	P	P	H
Missouri River (Hauser Dam-Holter Dam)	15,656	12,397	602	(n=4)	U	F	8	S	P	P	P	H
Prickly Pear Creek (Headwaters-Mouth)	2,596	5,069		(n=4)								
Rabbit Gulch-Forest Service Boundary					3	NB	0	-	-	P	S	L
Forest Service Boundary-East Helena					4	F/SR	3	S	S	P	S	M
Sevenmile Creek	138	39	-	(n=1)	U	-	-	-	-	-	-	-
Silver Creek		-		(n=0)	U	-	-	-	-	-	-	-
Sixteenmile Creek	3,621	1,040	-	(n=4)								
Ringling-MF					4	NB	0	-	-	P	-	L
MF Confluence-Missouri River					3	SR	1	-	-	P	S	L
Spokane Creek		155		(n=0)	U	-	-	-	-	-	-	-
Tenmile Creek	633	505	-	(n=3)								
Minnehaha Creek-Lazyman Trailhead					3	NB	0	-	-	P	P	M
Trout Creek	349 ~~1373~~	-	-	(n=2)								
Vigilante Camp-Missouri River					4	NB	0	-	-	-	S	M
Warm Springs Creek	273	-	-	(n=1)	U	-	-	-	-	-	-	-
Willow Creek	621	317	-	(n=4)	U	-	-	-	-	-	-	-

MISSOURI RIVER DRAINAGE-Holter Dam to Belt Creek

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Canyon Creek	647	869	-	(n=4)									
Headwaters-Virginia Creek					4	NB	0	-	-	P	-	M/L	0
Virginia Creek-Prickly Pear Creek					U	NB	0	-	-	-	-	L	0
Little Otter Creek	1,305	-	-	(n=1)	U	-	-	-	-	-	-	-	-
Little Prickly Pear Creek (Headwaters-Mouth)	1,640	4,487	-	(n=4)									
NF & SF Little Prickly Pear-Sieben					3	NB	0	-	-	P	-	M	0
Sieben-Missouri River					2	SR	3	P	-	P	P	H	2
Lyons Creek	212	-	-	(n=1)	U	-	-	-	-	-	-	-	-
Missouri River (Holter Dam-Cascade Bridge)	53,477	63,456	1,528	(n=4)									
Missouri R. (Cascade Bridge-Morony Dam)	21,214	14,130	303	(n=4)									
Holter Dam-Great Falls					1	F	9	P	P	P	S	H	>9
Sheep Creek	420	100	-	(n=1)	U	-	-	-	-	-	-	-	-
Stickney Creek	122	59	-	(n=2)	U	-	-	-	-	-	-	-	-
Virginia Creek		121		(n=0)									
Stemple Pass-Canyon Creek					3	NB	0	-	-	P	-	L	0
Wegner Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Wolf Creek	1,359	129	-	(n=4)	U	-	-	-	-	-	-	-	-

DEARBORN RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Dearborn River	1,672	1,556	25	(n=4)									
Scapegoat Wilderness Bdy.-Falls Creek					3	NB	0	-	-	P	S	M	1
Falls Creek-Hwy. 200 Bridge					2	MR	4	P	S	P	S	M	0
Hwy. 200 Bridge-Hwy. 287 Bridge					3	F	3	P	-	P	-	L	0
Hwy. 287 Bridge-Missouri River					1	MR	3	P	S	P	S	H	0
Flat Creek	404	116	-	(n=4)	U	-	-	-	-	-	-	-	-
MF Dearborn River		-		(n=0)									
Green Creek-Dearborn River					3	NB	0	-	-	P	P	H	0
~~Sheep Creek~~	~~420~~		-	~~(n=1)~~	~~U~~	-	-	-	-	-	-	-	-
SF Dearborn River		48		(n=0)	U	-	-	-	-	-	-	-	-

SMITH RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Big Birch Creek		60		(n=0)									
Headwaters-Gipsy Creek					3	NB	0	-	-	P	P	L	0
Eagle Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Hound Creek	1,079	703	-	(n=4)	U	-	-	-	-	-	-	-	-
Newlan Creek	461	169	-	(n=4)									
Headwaters-Forest Service Boundary					4	NB	0	-	-	P	S	L	0
NF Deep Creek		60		(n=0)	U	-	-	-	-	-	-	-	-
NF Smith River	450	60	-	(n=3)	U	-	-	-	-	-	-	-	-
Rock Creek	2,131	-	-	(n=2)	U	-	-	-	-	-	-	-	-
Sheep Creek	1,342	809	-	(n=3)									
Moose Creek-Black Butte Creek					3	NB	0	-	-	P	S	M	1
Smith River (Headwaters-Hound Creek)	8,080	10,498	81	(n=4)									
Confluence NF & SF-Fort Logan Bridge					3	F	2	S	-	P	S	L	0
Fort Logan Bridge-Camp Baker					2	F	2	P	P	P	P	H/M	0
Camp Baker-Eden Bridge					1	SR	5	P	P	P	-	H	>9
Smith River (Hound Creek-Mouth)	4,541	4,551	189	(n=4)									
Eden Bridge-Missouri River					3	F	6	S	P	P	P	M	0
SF Smith River	736	-	-	(n=2)	U	-	-	-	-	-	-	-	-
Tenderfoot Creek	313	843	-	(n=3)									
Headwaters-SF Tenderfoot Creek					3	NB	0	-	-	P	P	L	0
SF Tenderfoot Creek-Smith River					2	SR	5	S	-	P	S	M/L	0

Muddy Creek-Mouth
Willow Creek
Willow Creek Gorge

JUDITH RIVER DRA

STREAM

Beaver Creek
Big Spring Creek (He
Headwaters-Highwa
Big Spring Creek (Co
Hwy. 87 Lewistown-
Campbell Coulee
Cottonwood Creek
Cow Creek
EF Big Spring Creek
Judith River (Headwa
MF & SF Judith Rive
Judith River (Plum Cr
Danvers Bridge-And
Anderson Bridge-Mi
Little Trout Creek
Lost Fork Judith Rive
Louse Creek
McCarthy Creek
MF Judith River
Olsen Creek
Running Wolf Creek
NF & SF-Forest Ser
SF Judith River
Unnamed tributary of
Warm Spring Creek
Maiden-Judith River
Yogo Creek
Headwaters-MF Jud

BELT CREEK/MISSOURI DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Belt Creek (Headwaters-Mouth)	8,059	3,683	97	(n=4)								
Sec. 15-Monarch					3	MR	1	S	-	P	P	H/M
Monarch-Riceville					2	MR	4	P	-	P	S	M
Riceville Bridge-Missouri River					3	MR	6	P	-	P	P	H
Big Otter Creek		449		(n=0)								
Headwaters-Otter Creek					4	NB	0	-	-	S	S	M
Dry Fork Belt Creek		55		(n=0)								
Galena Creek-Belt Creek					3	NB	0	-	-	S	S	H

Belt Creek drainage (continued)	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Logging Creek	591	111	-	(n=3)									
Mill Creek-Belt Creek					2	NB	0	-	-	P	P	M	2
Pilgrim Creek	2,575	293	-	(n=1)									
T14N R6E Sec.2-Belt Creek					2	NB	0	-	-	P	P	M/L	0
Tillinghast Creek	3,219	48	-	(n=1)									
Keegan Butte-Belt Creek				4	NB	0	-	-	P	S	L	0	

MISSOURI RIVER DRAINAGE-Belt Creek to Fort Peck Reservoir

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Cut Bank Coulee		-	-	(n=0)	U	-	-	-	-	-	-	-	-
Highwood Creek	1,211	707		(n=4)	U	-	-	-	-	-	-	-	-
Missouri River (Morony Dam-Marias River)	7,640	2,056	141	(n=4)									
Morony Dam-Fort Benton					2	MR	9	P	P	P	P	H	1
Missouri River (Marias River-Fort Peck Dam)	5,225	10,177	19	(n=4)									
Fort Benton-Robinson Bridge					U	F	8	P	S	P	P	H	8
Robinson Bridge-Turkey Joe					1	F	6	P	P	S	S	M	6
Shonkin Creek	1,642	190	-	(n=4)	U	-	-	-	-	-	-	-	-

MARIAS RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11	12
Alkali Coulee		-		(n=0)	U	-	-	-	-	-	-	-	-
Badger Creek	261	52	-	(n=2)									
NF & SF Badger Cr.-Forest Service Boundary					3	NB	0	-	-	P	P	L	0
Forest Service Boundary-Mouth					3	SR	3	S	-	P	-	M	0
Bean Lake	7,215	3,800	-	(n=4)	U	-	-	-	-	-	-	-	-
Birch Creek	231	-	-	(n=2)									
Swift Dam-Marias River					4	SR	3	S	-	P	S	M	0
Cut Bank Creek (Cut Bank-Mouth)	386	97	-	(n=3)									
Sharp Lake-Sullivan Bridge (Mouth)					3	SR	3	S	-	P	-	L	0
Dry Fork Marias		-		(n=0)	U	-	-	-	-	-	-	-	-
Dupuyer Creek	620	1,369	-	(n=4)									
Confluence NF & SF-Dupuyer					U	NB	0	-	-	-	-	-	1
Gamble Coulee		-		(n=0)	U	-	-	-	-	-	-	-	-
Laughlin Coulee		-		(n=0)	U	-	-	-	-	-	-	-	-
Marias River (Cut Bank Creek-Lake Elwell)	1,924	1,311	21	(n=3)									
Cut Bank Creek-Tiber Reservoir					3	F	5	S	-	P	-	M	0
Marias River (Tiber Dam-Mouth)	3,156	3,981	39	(n=4)									
Tiber Reservoir-Circle Bridge					2	F	9	S	-	P	S	M/L	1
Circle Bridge-Missouri River					2	F/MR	9	S	S	P	S	M	0
Muddy Creek		-		(n=0)									
North Badger Creek		-		(n=0)									
Pool Creek-SF Badger Creek					3	NB	0	-	-	P	P	M	0
NF Dupuyer Creek		-		(n=0)									
Bob Marshall Wild.-SF Dupuyer Creek					3	NB	0	-	-	S	S	M	0
South Badger Creek		-		(n=0)									
Crucifixion Creek-SF Badger Creek					4	NB	0	-	-	P	S	L	0
SF Dupuyer Creek	105	-	-	(n=1)									
Bob Marshall Wild.-NF Dupuyer Creek					4	NB	0	-	-	S	S	L	0
SF Two Medicine River	344	-	-	(n=1)									
Forest Service Boundary-Sullivan Bridge					2	NB	0	-	-	P	S	L	0
Spring Coulee		-		(n=0)	U	-	-	-	-	-	-	-	-
Timber Coulee		-		(n=0)	U	-	-	-	-	-	-	-	-
Two Medicine River	806	634	-	(n=3)									
Forest Service Boundary-Sullivan Bridge					3	MR	3	S	-	P	-	L	O
Unnamed tributary of Bullhead Creek		-		(n=0)	U	-	-	-	-	-	-	-	-
Whitetail Creek	50	-	-	(n=1)	U	-	-	-	-	-	-	-	-

TETON RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Antelope Butte Swamp		-		(n=0)	U	-	-	-	-	-	-	-
Deep Creek		36		(n=0)	U	-	-	-	-	-	-	-
McDonald Creek		-		(n=0)	U	-	-	-	-	-	-	-
NF Deep Creek		-		(n=0)								
Slim Gulch-BLM Bdry. Sec. 18					4	NB	0	-	-	S	S	L
SF Deep Creek		-		(n=0)								
T23N R9W Sec. 22-NF Deep Creek					4	NB	0	-	-	P	S	M
Spring Creek		55		(n=0)	U	-	-	-	-	-	-	-
Teton River (Headwaters-Choteau)	390	552	14	(n=3)								
NF & SF Teton River-Choteau/Deep Creek					3	SR	3	S	-	P	-	L
Teton River (Choteau-Mouth)	632	299	4	(n=2)								
Choteau-Hwy. 91 (I-15)					3	SR	3	S	-	P	-	L
Hwy. 91 (I-15)-Coulee Fork					3	F	3	S	-	S	-	L
Coulee Fork-Marias River					3	F	4	S	-	P	-	L

MUSSELSHELL RIVER DRAINAGE

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Alabaugh Creek		-		(n=0)								
Headwaters-Robinson Creek					4	NB	0	-	-	S	S	L
American Fork Creek	1,106	302	-	(n=4)								
Headwaters-Musselshell River					4	NB	0	-	-	P	S	L
~~Big Dry Creek~~				~~(n=0)~~	~~U~~	-	-	-	-	-	-	-
Big Elk Creek	344	-	-	(n=1)	U	-	-	-	-	-	-	-
Careless Creek		95		(n=0)								
Headwaters-Forest Service Boundary					3	NB	0	-	-	S	P	M
Checkerboard Creek	186	-	-	(n=2)								
Main Forks-Forest Service Boundary					4	NB	0	-	-	S	S	L
Cottonwood Creek	361	59	-	(n=3)	U	-	-	-	-	-	-	-
Flatwillow Creek	740	803	-	(n=4)								
Confluence NF & SF-Hwy 87					3	NB	0	-	-	P	S	H
Hwy 87-Petrolia Lake					4	NB	0	-	-	P	-	L
Petrolia Lake-Musselshell River					3	NB	0	-	-	P	-	L
~~Little Dry Creek~~				~~(n=0)~~	~~U~~	-	-	-	-	-	-	-
Musselshell River (Headwaters-Lavina)	5,194	1,680	46	(n=4)	-	-	-	-	-	-	-	-
Musselshell River (Lavina-Mouth)	3,869	4,625	15	(n=4)								
NF & SF Confluence-Careless Creek					3	SR/MR	4	S	-	P	S	M
Careless Creek-Flatwillow Creek					4	F	2	S	-	P	S	L
Flatwillow Creek-Fort Peck Reservoir					3	F/MR	3	S	-	P	S	L
NF Musselshell (Headwaters-Mouth)	270	-	-	(n=3)	U	-	-	-	-	-	-	-
NF Musselshell (Bair Reservoir-SF Musselshell)					3	NB	0	-	-	P	P	M
SF Musselshell	281	75	-	(n=4)	U	-	-	-	-	-	-	-
Spring Creek	137	107	-	(n=1)								
Headwaters-NF Musselshell River					3	NB	0	-	-	P	P	H
Swimming Woman Creek		116		(n=0)								
Headwaters-Forest Service Boundary					2	NB	0	-	-	S	P	M

FORT PECK TRIBUTARIES

STREAM	1A	1B	2	3	4	5	6	7	8	9	10	11
Big Dry Creek		-		(n=0)	U	-	-	-	-	-	-	-
Little Dry Creek		-		(n=0)	U	-	-	-	-	-	-	-

Table 4-47. Angler use of reservoirs and lakes in the Headwaters Subbasin from 1982 to 1986

		Annual Angler Days[a]				
	(n)	1982-1983	1983-1984	1984-1985	1985-1986	Avg. 1982-1986
Clark Canyon Reservoir	(n=4)	~~58,311~~ 58,820	~~28,880~~ 30,162	~~38,256~~ 39,489	35,900	~~40,337~~ 41,093
Quake Lake	(n=4)	1,239	1,508	5,055	2,138	2,485
Ennis (Meadow) Lake	(n=4)	5,364	5,632	3,601	2,842	4,360
Hebgen Lake	(n=4)	49,282	52,848	35,476	44,630	45,559
Hyalite Reservoir	(n=4)	~~4,328~~ 10,775	~~4,304~~ 6,732	~~2,522~~ 4,762	~~2,294~~ 4,482	~~3,362~~ 6,688
Lima Reservoir	(n=0)	[b]	[b]	[b]	[b]	0
Lower Red Rock Lake	(n=2)	50	[b]	85	[b]	68
Ruby River Reservoir	(n=4)	2,813	8,894	1,781	2,528	4,004
Upper Red Rock Lake	(n=1)	[b]	[b]	85	[b]	85
Willow Creek Reservoir	(n=4)	5,689	18,665	7,748	6,405	9,627

n = number of years out of four with reported fishing pressure

[a] Angler day = one fisherman fishing one body of water for any length of time on one day

[b] No data available

Source: ~~DFWP~~ McFarland 1989.

425. **Comment**: On page 116, the description of recreational effects is misleading. The reservoir [Canyon Ferry] normally is drafted to its lowest level in March or April to allow for storage of the spring runoff. The March 1989 low elevation occurred when the lake was ice-covered and the boat landings were not needed. Canyon Ferry Reservoir normally is free of ice by April 7.

Response: The discussion on page 116 of the draft EIS of effects on recreation from low water levels at Canyon Ferry has been clarified as follows.

> Low reservoir levels from 1987 through 1990 have affected recreation at Canyon Ferry Reservoir. In the spring of 1989, the surface water level was more than 20 feet below the normal operating elevation of 3,797 feet. Boat access was difficult because some ramps did not reach the water. Water surface at Canyon Ferry Reservoir reached a 30-year low level in March 1989 at 3,774 feet—23 feet below full pool. Most boat ramps on Canyon Ferry are unusable below 3,777 feet (Campbell 1990). The 3,777-foot elevation was reached in May 1989 as the reservoir filled. Low water also caused problems for private cabin owners when docks became unusable. Exposure of rocks and sand bars created nuisances and hazards for motor boats and waterskiers.

426. **Comment**: It appears that the references to angler days in the text (page 118) should read McFarland 1989c, not DFWP 1989.

Response: The cite has been changed to "McFarland 1989" on page 118, column 2, in the second complete paragraph.

427. **Comment**: On page 119, Table 4-50, 1991 floating data on the Smith River are available for inclusio in this discussion.

Response:

Table 4-50. Smith River floating

	1984	1985	1986	1987	1988	1989	1990	1991
Number of registered floaters	1,971	854	1,962	1,242	1,462	2,395	2,654	2,874[b]
Date when river bacame generally unfloatable[a]	July 15	June 15	August 1	June 17	June 6	June 25	July 9	July 12

[a] 100 cfs at Camp Baker

[b] April 1 - August 31

Sources: Heagney 1990, Cheek 1989, DFWP 1991, Haberman 1991

428. **Comment**: On page 124, Ackley Lake is said to be in the Musselshell River basin. It is in the Judith Riv basin.

Response:

MUSSELSHELL RIVER DRAINAGE

Several reservoirs are used for fishing and other water-related recreation (Table 4-53). These include Bair Reservoir on the North Fork of the Musselshell River, Martinsdale Reservoir near Martinsdale, Deadmans Basin Reservoir near Shawmut, ~~Ackley Lake west of Lewistown,~~ and Petrolia Reservoir on Flatwillow Creek. Deadmans Basin and Martinsdale reservoirs have developed facilities for shoreline activities, including several summer cabins at Deadmans Basin.

429. **Comment**: On page 126, Table 4-56 outlines MPC's planned modifications to its Missouri River bas hydroelectric facilities. The table states that no modifications will be made to the historic release patter at Holter. It is more accurate to say that no modifications will be made to the recent release patterns at Holte

The table also states that the dam at Cochrane will be raised to produce additional head. This incorrect. The dam at Cochrane will not be raised. Cochrane has not been filled to capacity because would result in flooding at the upstream Rainbow Dam. The new construction at Rainbow, which wa anticipated when Cochrane was built, will allow the full head at Cochrane to be used without modific tion to the Cochrane Dam. The operations at Cochrane will be modified to allow for load shaping at Rya Dam and Cochrane Dam. Morony Dam will then be operated to maintain stable releases downstrea in the Missouri River.

Response:

Table 4-56. Planned modifications to MPC's Missouri basin hydroelectric facilities.

HOLTER: No modifications to the facilities or to ~~historical~~ recent release patterns.

COCHRANE: ~~Raise dam to produce more head. This would be done in conjunction with tailrace modifications at Rainbow Dam.~~ Modify operations to allow for load shaping at Cochrane and Ryan ~~Dam~~ dams.

430. **Comment**: On page 126, under "Federal Relicensing of MPC's Dams," DNRC states that MPC's planned changes to its Missouri River dams "would provide about 63 additional MW of capacity." This sentence would be more accurate if it were changed.

Response:

FEDERAL RELICENSING OF MPC'S DAMS

MPC operates these facilities under a 50-year license from the Federal Energy Regulatory Commission (FERC), and the license is due to expire in 1994. MPC must submit an application for a new license by 1992. In this application, MPC plans to propose that several of the dams be repaired, upgraded, and expanded (Table 4-56). Upgrading the generation facilities would provide about ~~63~~ 68 additional MW of capacity and about 9 average MW of energy.

431. **Comment**: On page 150, Table 5-1, BUREC's Virgelle application is excluded from the Combination Alternative. Pages 153 and 180 indicate that it should have been included.

Response:

Table 5-1. Reservation requests included under each alternative

MIDDLE MISSOURI SUBBASIN

**Missouri River Drainage—
Belt Creek to Fort Peck Reservoir**

				ALTERNATIVES			
APPLICANT/ PROJECT	SOURCE	TYPE OF RESERVATION	AMOUNT (cfs)	CONSUMPTIVE USE	INSTREAM	COMBINATION	NO ACTION
Fort Benton	Missouri River	Municipal	0.8	■	■	■	
CHFG-181	Cut Bank Coulee	Irrigation	7.9	▨	▨	░	
CH-541	Highwood Creek	Irrigation	0.2	▨		▨	
BUREC.	Missouri River near Virgelle	Irrigation	280.0	▨		▨	

432. **Comment**: On page 175, under "Legal Water Availability," second paragraph, July 1, 1983, should read July 1, 1973.

Response:

LEGAL WATER AVAILABILITY

For the purposes of this draft EIS, DNRC identified some areas where there has been conflict between new appropriators and existing water right holders. DNRC searched the water rights data base to identify streams where reservations are proposed and where existing water right holders filed objections to applications for water use permits between July 1, ~~1983~~ 1973, and November 1989. The results of this analysis, which also include objections to groundwater wells, are summarized in Table 6-4. DNRC's staff at water ~~rights field~~ resources regional offices in Bozeman, Lewistown, Havre, and Helena identified streams and groundwater sources where there are problems and concerns regarding water allocations (Table 6-5).

433. **Comment**: On page 181, Table 6-7, the figures accumulated in the table do not match the figures in th narrative. If there is a reason for the difference, please note. Otherwise, these values should match.

Response: As listed in Table 6-7, the City of Bozeman proposes a reservoir on Sourdough Creek wit a total storage of approximately 6,000 af. The city estimates that this proposed reservoir would have a annual reliable yield of approximately 4,000 af (City of Bozeman 1987). The figures used in the narrativ represent the reservoir's reliable yield rather than its total capacity. The narrative numbers should b increased by approximately 2,000 af to agree with the table. The correction is made as follows.

STORAGE

Fifteen storage projects are included in the reservation applications as summarized in Table 6-7. Of these, the City of Bozeman's proposed 6,000 acre-foot reservoir on Sourdough Creek is the largest. The total volume stored by all 15 projects would be ~~9,357~~ 11,342 acre-feet under the Consumptive Use Alternative, ~~7,490~~ 9,475 acre-feet under the Combination Alternative, and ~~7,117~~ 9,102 acre-feet under the Instream Alternative. This increase in volume is small in comparison to the estimated 26 million acre-feet presently stored in the basin.

434. **Comment**: I [Trout Unlimited] suggest one correction to Table 6-10 on page 185. This table purport to identify consumptive reservations that may damage aquatic life by increasing water temperatures an decreasing dissolved oxygen. Noticeably absent from this table is project GA-201, which on page 204 yo acknowledge may increase water temperatures and adversely affect fisheries. GA-201 should b included in Table 6-10.

Response:

Table 6-10. Requested consumptive use reservations that might damage aquatic life by increasing water temperatures and decreasing dissolved oxygen under the different alternatives

Subbasin/Streams	Consumptive Use Alternative	Instream Alternative	Combination Alternative
Headwaters Subbasin			
Jefferson River	BR-52	None	BR-52
	BR-101		BR-101
	GA-102		GA-102
	JV-203		JB-55
	JV-55		
	JV-95		
	JV-204		
	JV-202		
	JV-25		
Madison River	GA-201	None	GA-201
Boulder River	JV-18	None	JV-18
	JV-80		JV-80
	JV-17		JV-17
	JV-81		JV-81
	JV-63		JV- 63

435. **Comment:** On page 202, fifth paragraph, change 47 to 48 percent.

Response:

In this analysis, streamflow rates that maintain riffle areas and side-channel habitat are used as indicators of aquatic habitat condition. These rates were determined by DFWP after field investigations. Generally, flows necessary to maintain good riffle habitat average 27 to ~~47~~ 48 percent of the average annual flow (see Appendix B). Other methods are available to approximate the amount of flow necessary to support aquatic habitat on a given stream. The methods used by DFWP and BLM are discussed in Appendix B.

436. **Comment:** On page 204, third paragraph, the reference USGS 1989b may not be correct for the statement that 11 cfs is necessary to maintain good amounts of food-producing riffle areas. The reference probably should be DFWP 1989.

Response:

Fishery impacts of Bozeman's proposed dam are difficult to estimate because of uncertainties about reservoir operations. However, under all the alternatives, about 1.25 miles of stream habitat would be inundated. It is unknown if reservoir operation would sustain a long-term fishery in the reservoir or Sourdough Creek below the proposed dam. In Sourdough Creek near the National Forest boundary, the reservation might reduce flows to 11 cfs or less. Flows greater than 11 cfs are thought necessary to maintain good amounts of food-producing riffle areas (~~USGS 1989b~~ DFWP 1989). Flows now fall below 11 cfs during the fall and winter (USGS 1989b).

437. **Comment:** In Table 6-41, the July-August flow reduction for the upper Missouri subbasin under the combination alternative (20,470.5 acre-feet) exceeds the value for the consumptive alternative (20,163.1 acre-feet). Is this possible?

Response: Table 6-41 has been revised.

Table 6-41. Average flow reductions (acre-feet) from different alternatives

Alternative	Flow reductions during July and August	Flow reductions during the rest of year
Consumptive Use		
Headwaters Subbasin	38,850.9	11,189.1
Upper Missouri Subbasin	~~20,163.1~~ 49,608.7	51,193.6
Marias/Teton Subbasin	29,691.5	16,210.5
Middle Missouri Subbasin	125,897.0	89,993.0
Instream		
Headwaters Subbasin	0.0	121.0
Upper Missouri Subbasin	7,991.5	7,755.0
Marias/Teton Subbasin	2,397.5	1,554.7
Middle Missouri Subbasin	13,462.6	10,504.0
Combination		
Headwaters Subbasin	18,933.7	5,123.6
Upper Missouri Subbasin	20,470.5	20,743.2
Marias/Teton Subbasin	7,745.6	~~6,950.1~~ 3,950.1
Middle Missouri Subbasin	51,084.1	35,983.0

438. **Comment**: On page 250, under "Montana Department of Fish, Wildlife and Parks," fourth paragraph the second sentence should be changed.

Response:

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

The Fixed Percentage Method was used on 27 streams. Desirable flow amounts are assumed to equal a fixed percentage of the estimated average annual flow. While this method can be used as a general indicator of flows necessary to protect aquatic habitat, the assessment it provides is less sensitive to conditions in individual streams than the WETP method.

439. **Comment**: On page B-3, under "Wetted Perimeter Inflection Point Method," the first paragraph shoul be changed.

Response:

WETTED PERIMETER INFLECTION POINT METHOD

In determining the amount of instream flow necessary to protect habitat in riffle areas of most streams, DFWP and BLM used the Wetted Perimeter Inflection Point (WETP) method of calculation (DFWP 1989). This method is based on the assumptions that aquatic organisms ~~making up~~ contributing the majority of food for game fish are produced in riffle areas, and that food supply for the fish is a major factor in determining the number and weight of fish a stream can support during the warmer months when fish grow and new fish are recruited into the population. Riffles also are used by many game fish for spawning and rearing of their young. Wetted perimeter is the linear distance along the bottom and sides of a stream that is in contact with water when the stream is viewed in cross section (see Figure B-1). As flows change, the wetted perimeter changes. If water is maintained in riffles, a substantial amount of stream width will extend near enough to streamside vegetation to provide shade and protection to pools and runs where adult fish reside.

440. **Comment**: On page B-4, under "Base Flow Approach," the second sentence in the first paragrap should be changed.

Response:

BASE FLOW APPROACH

The WETP method and fixed percentage approach do not work very well on spring creeks. On 17 high-quality spring creeks (Table B-3), DFWP is requesting that the lowest average monthly flow for the year (the base flow) that typically occurs ~~during the~~ in winter be allocated for instream purposes year-round.

441. **Comment**: On page B-5, under "Other Approaches," the last sentence in the paragraph should b changed.

Response:

OTHER APPROACHES

DFWP also requested reservation of all remaining unappropriated water on four streams (Table B-4) to protect water quality and fisheries of the East Gallatin River. All remaining unappropriated water was requested on three tributaries (Table B-4) of the Madison River below Hebgen Dam to ensure adequate flow in the Madison when water is not being released from the dam. ~~Lastly, on~~ On two intermittent tributaries of the Missouri River (Table B-4), ~~one-half the average annual~~ the mean monthly flow was requested during four months each year to protect a rainbow trout spawning run.

442. **Comment**: On page B-5, Table B-4, under the request column for Stickney Creek and Wegner Creek, mean annual flow should read mean monthly flow.

Response:

Table B-4. Streams where DFWP used other approaches to determine instream flow requests

Stream Reach	Request	Reason
East Gallatin River-Reach 1 Bridger Creek Rocky Creek Sourdough Creek	All remaining unappropriated water	To protect water quality in the East Gallatin River for fisheries purposes
Beaver Creek Cabin Creek West Fork Madison River	All remaining unappropriated water	To offset flow reductions due to storage at Hebgen Reservoir
Stickney Creek Wegner Creek	Mean ~~annual~~ monthly flow for four months of the year	To allow rainbow trout from the Missouri to spawn in these intermittent streams

443. **Comment**: On page D-3, the following streams are missing from Table D-1: Under Red Rock and Beaverhead drainage: Poindexter Slough; Jefferson drainage: Willow Spring Creek; Madison drainage: Black Sand Spring Creek; Big Hole drainage: Rock Creek at mouth near Wisdom and Delano Creek at mouth near Wise River; Jefferson drainage: Halfway Creek at mouth near Whitehall; Smith River drainage: North Fork Deep Creek at mouth near Milligan; Musselshell River drainage: Collar Gulch at mouth near Maiden; Marias River drainage: Badger Creek below forks near Browning.

Response: The flow records on the following page have been added to Table D-1.

444. **Comment**: On page D-15, under the Dearborn River drainage, Sheep Creek at mouth near Cascade is not a tributary to the Dearborn.

Response:

Table D-1. Estimated flows (cfs) for the 50-year period from 1937 to 1986 where reservations are requested

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
DEARBORN RIVER DRAINAGE													
~~Sheep Creek at mouth near Cascade~~													
~~90 %~~	~~13~~	~~10~~	~~8~~	~~6~~	~~7~~	~~7~~	~~11~~	~~57~~	~~68~~	~~33~~	~~17~~	~~14~~	~~21~~
~~80 %~~	~~16~~	~~12~~	~~9~~	~~8~~	~~8~~	~~8~~	~~15~~	~~77~~	~~110~~	~~53~~	~~24~~	~~19~~	~~30~~
~~50 %~~	~~23~~	~~17~~	~~12~~	~~11~~	~~10~~	~~9~~	~~31~~	~~190~~	~~220~~	~~80~~	~~36~~	~~26~~	~~55~~
~~20 %~~	~~25~~	~~18~~	~~13~~	~~12~~	~~13~~	~~12~~	~~56~~	~~310~~	~~310~~	~~97~~	~~56~~	~~36~~	~~80~~
~~AVG~~	~~21~~	~~15~~	~~11~~	~~10~~	~~10~~	~~9~~	~~36~~	~~210~~	~~230~~	~~84~~	~~38~~	~~28~~	~~58~~
MISSOURI RIVER DRAINAGE - HOLTER DAM TO BELT CREEK													
Sheep Creek at mouth near Cascade													
90 %	13	10	8	6	7	7	11	57	68	33	17	14	21
80 %	16	12	9	8	8	8	15	77	110	53	24	19	30
50 %	23	17	12	11	10	9	31	190	220	80	36	26	55
20 %	25	18	13	12	13	12	56	310	310	97	56	36	80
AVG	21	15	11	10	10	9	36	210	230	84	38	28	58

Table D-1 (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
MADISON RIVER DRAINAGE													
Black Sand Spring Creek													
90%	15	15	15	14	15	15	18	28	23	16	14	15	17
80%	17	17	18	16	16	17	19	30	27	19	16	17	19
50%	19	19	19	18	18	18	20	35	37	23	19	18	22
20%	22	21	21	20	20	19	24	44	45	30	23	22	26
AVG	19	19	19	18	18	18	21	38	37	23	19	19	22
JEFFERSON RIVER DRAINAGE													
Halfway Creek													
90%	.7	2.0	.9	.7	.7	1.2	2.3	11.0	6.2	1.0	.5	.5	2.2
80%	1.0	1.1	1.0	.9	1.0	1.4	3.1	13.1	9.2	1.9	.6	.7	2.9
50%	1.4	1.4	1.2	1.2	1.3	1.7	5.4	20.6	18.0	3.3	1.0	1.0	4.8
20%	2.4	1.8	1.5	1.4	2.9	2.4	9.4	27.7	30.8	7.7	1.7	1.7	7.6
AVG	1.6	1.5	1.2	1.1	1.3	2.0	6.3	20.8	19.3	4.7	1.2	1.2	5.2
Willow Spring Creek													
90%	10	9	8	8	8	8	9	12	14	12	10	9	10
80%	10	9	8	8	8	8	9	12	14	12	10	9	10
50%	10	9	9	9	8	9	9	14	18	14	11	10	11
20%	11	10	9	9	9	9	11	16	19	16	13	11	12
AVG	10	9	9	9	9	9	10	14	17	14	11	11	11
BIG HOLE RIVER DRAINAGE													
Delano Creek													
90%	.4	.3	.3	.3	.3	.3	.4	1.3	1.8	.9	.5	.5	.6
80%	.4	.4	.3	.3	.3	.3	.4	1.3	2.4	.9	.7	.5	.7
50%	.5	.4	.4	.3	.3	.3	.5	1.9	3.2	1.5	.8	.6	.9
20%	.6	.5	.4	.4	.4	.4	.7	2.3	3.9	1.9	1.0	.7	1.1
AVG	.5	.4	.4	.3	.3	.3	.5	1.9	3.2	1.5	.8	.6	.9
Rock Creek													
90%	6.4	5.3	4.5	4.7	4.1	4.3	5.7	20.4	31.0	14.6	8.4	7.3	9.7
80%	7.1	6.0	4.9	4.9	4.8	4.8	6.7	22.0	39.4	15.1	11.6	8.3	11.6
50%	8.6	7.2	6.2	5.9	5.5	5.9	8.6	32.3	55.4	24.6	15.1	10.1	15.4
20%	10.4	8.9	7.3	6.9	6.7	8.9	12.8	41.4	69.0	33.5	17.9	12.6	19.7
AVG	8.8	7.4	6.1	5.8	5.7	6.0	9.4	33.0	56.5	26.7	14.8	10.4	15.7
BEAVERHEAD RIVER DRAINAGE													
Poindexter Slough													
90%	63	63	56	56	49	46	49	60	63	70	65	63	58
80%	70	65	60	63	58	53	63	70	75	72	70	67	65
50%	77	77	70	72	70	70	75	93	89	82	75	75	77
20%	84	81	74	79	95	102	95	102	96	86	81	81	86
AVG	76	74	67	69	67	67	76	86	86	81	74	74	74
SMITH RIVER DRAINAGE													
North Fork of Deep Creek													
90%	1.4	1.1	.9	.7	.9	.9	1.3	7.0	6.2	2.8	1.8	1.5	2.2
80%	1.6	1.3	1.0	1.0	1.0	1.0	1.5	8.5	8.3	4.0	2.4	1.9	2.8
50%	2.0	1.7	1.4	1.3	1.2	1.2	2.4	11.5	13.5	5.3	2.9	2.3	3.9
20%	2.3	2.0	1.6	1.5	1.4	1.4	1.1	17.4	20.4	7.3	3.9	2.9	5.5
AVG	2.1	1.7	1.4	1.2	1.2	1.3	2.8	12.7	14.8	5.7	3.1	2.4	4.2
MARIAS RIVER DRAINAGE													
Badger Creek													
90%	60	56	43	41	48	50	55	311	189	93	68	61	90
80%	64	58	50	48	52	54	78	337	237	114	78	70	103
50%	77	68	62	53	61	63	123	424	375	140	95	78	135
20%	91	84	78	69	68	73	158	496	576	233	116	94	178
AVG	82	72	65	56	62	66	120	422	434	171	97	84	144
TETON RIVER DRAINAGE													
Spring Creek													
90%	4.5	4.3	4.3	4.3	4.2	4.3	4.3	4.1	4.2	4.3	4.5	4.5	4.3
80%	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.3	4.6	4.5	4.6	4.6	4.5
50%	4.8	4.7	4.6	4.7	4.6	4.7	4.7	4.6	4.8	4.7	4.7	4.8	4.7
20%	5.0	4.9	4.8	4.9	4.8	4.9	4.9	4.8	5.0	4.9	4.9	5.0	4.9
AVG	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.5	4.8	4.7	4.8	4.8	4.7
MUSSELSHELL RIVER DRAINAGE													
Collar Gulch													
90%	.1	.03	.02	.02	.01	.03	.2	1.3	1.5	.3	.1	.1	.3
80%	.1	.1	.1	.1	.1	.1	.4	1.9	2.6	.4	.1	.1	.5
50%	.6	.8	.6	.5	.6	.7	1.2	3.3	4.6	.9	.3	.4	1.2
20%	1.3	1.2	.9	.7	.8	1.0	2.1	5.4	8.4	1.9	.6	.9	2.1
AVG	.8	.8	.6	.5	.5	.7	1.4	3.8	5.6	1.4	.4	.5	1.4

445. **Comment**: For page E-3, Table E-1, corrected copies of this table from the draft EIS are attached.

Response: For the draft EIS, DNRC queried BLM, DFWP, DHES, and DNRC's regional offices for information about water quality impairments and streams with critical low flows. In January 1991, DFWP submitted revised data designating "chronic" and "periodic" low flow streams. Tables E-1, 4-2, and 4-4 have been changed to reflect new information and to correct nomenclature errors. Hot Springs Creek is not indicated in DFWP's January 1991 list. Red Canyon Creek and Cow Creek were not shown to have impairments to water quality during DNRC's review of the data. Hell's Canyon Creek is listed in the periodic dewatering section of the DFWP list and is removed from the critical low flow list. Swamp Creek is not listed as chronic or critical low flow, but is listed as a periodic low flow problem in the DFWP January 1991 submittal. Also see response to comment 85. DNRC chose to use the term "critical low flow" on those streams for which published documentation existed or for which more than one agency indicated the existence of severe dewatering problems.

Table E-1. Water quality classifications and impairments for streams where reservations are requested

Gallatin Drainage

Stream/Reach[a]	Classification	Water Quality Impairments[b]
E Gallatin River #1 ~~below~~ above wastewater treatment plant	B-1	Sediment, nutrients, ~~other~~
Gallatin River #1	B-1	~~Critical low flow~~ None
Hell ~~Raising~~ Roaring Creek	A-1/B-1	None
Middle Fork Hyalite Creek #1	A-1/B-1	~~Critical low flow~~ None
Middle Fork Hyalite Creek #2	B-1	Sediment, pH, nutrients, critical low flow

Madison Drainage

Stream/Reach[a]	Classification	Water Quality Impairments[b]
North Meadow Creek	B-1	Critical low flow
S Fork Madison River	B-1	None~~p~~

Jefferson and Boulder Drainages

Stream/Reach[a]	Classification	Water Quality Impairments[b]
Hells Canyon Creek	B-1	~~Critical low flow~~ None
S Willow Creek	B-1	~~None~~ Critical low flow
Willow Springs Creek	B-1	~~Critical low flow~~ None

Big Hole and Ruby Drainages

Stream/Reach[a]	Classification	Water Quality Impairments[b]
~~Alder Creek~~	~~B-1~~	~~Critical low flow~~
E Fork Ruby River	B-1	Sediment~~, critical low flow~~
Ruby River #2	B-1	Sediment, critical low flow
~~Steel Creek~~	~~B-1~~	~~Critical low flow~~
~~Warm Springs Creek~~	~~A-1~~	~~None~~

Missouri River - Holter Dam to Belt Creek

Stream/Reach[a]	Classification	Water Quality Impairments[b]
Sheep Creek	B-1	None

Dearborn Drainage

Stream/Reach[a]	Classification	Water Quality Impairments[b]
Flat Creek	B-1	~~None~~ Sediment
~~Sheep Creek~~	~~B-1~~	~~None~~

Missouri River - Belt Creek to Fort Peck Reservoir

Stream/Reach[a]	Classification	Water Quality Impairments[b]
Big Dry Creek	C-3	None
Little Dry Creek	C-3	None

Musselshell Drainage

Stream/Reach[a]	Classification	Water Quality Impairments[b]
~~Big Dry Creek~~	~~C-3~~	~~None~~
~~Little Dry Creek~~	~~C-3~~	~~None~~

[a] Note: Stream/reach locations #1, #2, etc., are described in the DFWP application, June 1989.

[b] Source: DHES 1984,1986; DFWP 1985-~~1989~~ 1991, BLM 1985-1989; DNRC 1985-1991

446 a. **Comment**: There are many inaccuracies in these draft EIS tables as I read them. I would like to point out the following:

Appendix G, Table G-1, Big Hole River #3 - This table lists the brown trout as being rare in this stretch of the river; brown trout are what everyone fishes for.

b. **Comment**: We have attached copies of Table G-1 (pp. G-4, G-9, and G-10) with the necessary corrections.

Response: Revised pages G-4, G-5, G-9, and G-10 are on the following four pages.

447. **Comment**: In Appendix H, Table H-1, the recreation data from MRIS are cited incorrectly. Sources for columns 4 through 12 should read "Recreation portion of the Montana Rivers Information System," not the Natural Resource Information System (NRIS). NRIS houses and disseminates data from a variety of data bases, including MRIS.

Response: The following change has been made to all pages in Appendix H, Table H-1.

Table H-1. Recreation information for rivers and streams with reservation requests

Sources: Columns 1 through 3: DFWP 1989.
Columns 4 through 12: ~~Natural Resource Information System~~ Recreation portion of the Montana Rivers Information System 1989. Comprehensive recreation information is not available for all streams.

Headwaters subbasin (continued)

Key to Symbols:		
	1=outstanding	4=moderate
	2=high value	5=limited
	3=substantial	6=insufficient information to classify stream

A=abundant; C=common; P=present; PE=presence expected but not confirmed; U=uncommon; R=rare

Stream	Fisheries Resource Value Class	FAMILY	Sturgeon		Paddlefish	Mooneye	Trout								Pike	Minnow																	Sucker									Catfish			Codfish	Sunfish							Perch				Drum	Sculpin	Stickleback
		COMMON NAME	Pallid sturgeon	Shovelnose sturgeon	Paddlefish	Goldeye	Mountain whitefish	Kokanee	Cutthroat trout	Rainbow/cutthroat hybrid	Rainbow trout	Brown trout	Brook trout	Arctic grayling	Northern pike	Carp	Minnow	N. Redbelly x finescale dace	Utah chub	Flathead chub	Sturgeon chub	Lake chub	Sicklefin chub	Emerald shiner	Redside shiner	Sand shiner	Brassy minnow	Plains minnow	Plains/silvery minnow	Silvery minnow	Fathead minnow	Longnose dace	River carpsucker	Blue sucker	Smallmouth buffalo	Bigmouth buffalo	Shorthead redhorse	Longnose sucker	White sucker	Largescale sucker	Mountain sucker	Black bullhead	Channel catfish	Stonecat	Burbot	Green sunfish	Pumpkinseed	Bluegill	Smallmouth bass	Largemouth bass	White crappie	Black crappie	Yellow perch	Sauger	Walleye	Iowa darter	Freshwater drum	Mottled sculpin	Brook stickleback
MADISON RIVER DRAINAGE																																																											
Antelope Creek	2										A																												P																		P	
Beaver Creek	4						C				U	U																																													C	
Black Sand Spring Creek	2								U		C	C	P																																													
Blaine Spring Creek	2										C	C																										U																			C	
Cabin Creek																																																											
6mi. Above Mouth-0.5mi. Above Mouth	4								P		P																																															
Cub Creek-Mouth	4						U				U	U																										P																			C	
Cherry Creek	4						P				C	U	P																																												C	
Cougar Creek	3						A				U	A	U																																												U	
Duck Creek	3						A		P		U	A	U																																												U	
Elk River	4								P	P	U	C																																													C	
Grayling Creek	6						P		P	P	P	P	P																																												P	
Hot Springs Creek	4						PE				C	C	P																				P						P			P																	C	
Indian Creek	4								U		C	P																																														C	
Jack Creek	3						U				C	C																					P																										C	
Madison River #1	1						A		U		A	A	U						A														PE																										A	
Madison River #2																																																											
Sheep Creek-Varney Bridge	1						A		U		A	A	U																				A																										A	
Hebgen Lake-Sheep Creek	1						A				A	A							A														A																										A	
Madison River #3	1						A				A	A	U	U					A														A							P		P																	A	
Madison River #4																																																											
Greycliff Access-Mouth	1						A		P		A	A	P	P		C			U														A						A	A		A			A									U					A	
Ennis Lake-Greycliff Access	1						A				A	A		P																			A						A	A		A			U														A	
Moore Creek																																																											
Source-Hwy. 287 in Ennis	4										U	U																											P																			P	
Hwy. 287 in Ennis-Mouth	2										A			A																																													
North Meadow Creek																																																											
Sureshot Lakes Fork-National Forest	3								U		U		C																																													C	
National Forest-Mouth	3						C		U		C	C	U	U																																													C	
O'Dell Spring Creek	6						P				P	P	P																																													
Red Canyon Creek	6								P		P																																															
Ruby Creek	3								U		C	U																																														C	
SF of the Madison River																																																											
Headwaters-Railroad Line	3										U	C	U																																													C	
Railroad Line-Mouth	2						A				U	A	U																																													C	
Squaw Creek	4								C		U	P	U																																													C	
Standard Creek	4								U	P	U	P		P																																												C	
Trapper Creek	6								P		P																																															
Watkins Creek	6								P		P																																															P	
WF of the Madison River																																																											
Meridian Creek-Soap Creek	3								U		U	U	C																																													C	
Soap Creek-Mouth	3						U				U	C	U																																													C	
Whiskey Spring	6											P	P																																													
JEFFERSON RIVER DRAINAGE																																																											
Boulder River #1																																																											
Basin-Boulder	4						U				C		U																				U						U	U																			C	
Headwaters-Basin	4						C		PE		C		C																				U						U	U																			A	
Boulder River #2	4						U				U	C	U																				U						U	U																			U	

Headwaters subbasin (continued)

Key to Symbols: 1=outstanding 2=high value 3=substantial 4=moderate 5=limited 6=insufficient information to classify stream

A=abundant; C=common; P=present; PE=presence expected but not confirmed; U=uncommon; R=rare

		FAMILY	Sturgeon		Paddlefish	Mooneye	Trout								Pike	Minnow																	Sucker									Catfish			Codfish	Sunfish							Perch				Drum	Sculpin	Stickleback
Stream	Fisheries Resource Value Class	COMMON NAME	Pallid sturgeon	Shovelnose sturgeon	Paddlefish	Goldeye	Mountain whitefish	Kokanee	Cutthroat trout	Rainbow/cutthroat hybrid	Rainbow trout	Brown trout	Brook trout	Arctic grayling	Northern pike	Carp	Minnow	N. Redbelly x finescale dace	Utah chub	Flathead chub	Sturgeon chub	Lake chub	Sicklefin chub	Emerald shiner	Redside shiner	Sand shiner	Brassy minnow	Plains minnow	Plains/silvery minnow	Silvery minnow	Fathead minnow	Longnose dace	River carpsucker	Blue sucker	Smallmouth buffalo	Bigmouth buffalo	Shorthead redhorse	Longnose sucker	White sucker	Largescale sucker	Mountain sucker	Black bullhead	Channel catfish	Stonecat	Burbot	Green sunfish	Pumpkinseed	Bluegill	Smallmouth bass	Largemouth bass	White crappie	Black crappie	Yellow perch	Sauger	Walleye	Iowa darter	Freshwater drum	Mottled sculpin	Brook stickleback
Boulder River #3	3						U				U	A	U																			U						U	U																			U	
Halfway Creek																																																											
Headwaters-Halfway Park	1								A																																																		
Finn Cabins-Mouth	4								PE				C																																														
Hells Canyon Creek																																																											
Source-National Forest	4									A	P	C	U																																													C	
National Forest-Mouth	2									A		C																											U																			C	
Jefferson River																																																											
Headwaters-Fish Creek	2						A				C	A				PE																PE						PE	PE																			PE	
Fish Creek-Big Pipestone Creek	2						A				C	A				PE																PE						PE	PE																			PE	
Big Pipestone Creek-Mouth	2						A				C	A	R			C				U					PE							U						A	A		U			R						R		R	R					U	
Little Boulder River																																																											
Headwaters-National Forest	4								U		C		C																																													A	
National Forest-Mouth	4						U				C	C	C																			C						U	U																			A	
North Willow Creek	3						R	U			C	C	R																			C						C	C																			C	
South Boulder River																																																											
Headwaters-National Forest	3										U		A																																													C	
National Forest-Hwy 359 Bridge	3										C		C																																													C	
Hwy 359 Bridge-Mouth	4						U				U	U	U																																													C	
South Willow Creek	3						R	U			C	C	R																			C						C	C																			C	
Whitetail Creek																																																											
Whitetail Reservoir-N. Boundary Sec. 4	6												P																																														
N. Boundary Sec. 4-SE Corner Sec. 36	4								PE			C	U																																														
SE Corner Sec. 36-Mouth	4											C	U																																														
Willow Creek																																																											
N & S Willow Creek-Willow Creek Reservoir	3							U			C	U	C																									C	C																			C	
Willow Creek Dam-Mouth	3						C				U	C	R																			U						U	C		R																	C	
Willow Spring Creek	2										P	U	C																																														
BIG HOLE RIVER DRAINAGE																																																											
American Creek	6									P	P		P																																													P	
Bear Creek	3									U			A																																													U	
Big Hole River, #1 #3	1						C		R		U	C	U	R		U																U						C	C		U				U													C	
Big Hole River, #2	1																																																										
Wise River-Divide	1						A		U		U	C	C	U																		U						C	C		U				U													C	
Pintlar Creek-Wise River	1						A		R		C	U	R	R																		U						C	C		U				C													C	
Big Hole River, #3 #1	1						A		R		R	R	C	U																		C						C	U		U				C													C	
Big Lake Creek	1						C						A	R																		A						C							PE													PE	
Birch Creek	4																																																										
Beaverhead/Willow Creek Ditch-Mouth	4										C		P																																													P	
Headwaters-Beaverhead/Willow Creek Ditch	4								U		R		C																																													A	
Bryant Creek	6												P																																													P	
California Creek	6						P				P		P																			P						P																				P	
Camp Creek	4								C	U	U	PE	C																																													U	
Canyon Creek	3								R	A	R	PE	C																																													A	
Corral Creek	3										R		A																																													P	
Deep Creek	3																																																										
French Creek-Mouth	3						U				C		U	P																		A						U							U													C	
Headwaters-French Creek	3						U		P		U		A																			A						C			A				U													A	

Upper Missouri subbasin

Key to Symbols:		
1=outstanding	4=moderate	
2=high value	5=limited	
3=substantial	6=insufficient information to classify stream	

A=abundant; C=common; P=present; PE=presence expected but not confirmed; U=uncommon; R=rare

		FAMILY	Sturgeon		Paddlefish	Mooneye	Trout								Pike	Minnow																	Sucker									Catfish			Codfish	Sunfish							Perch				Drum	Sculpin	Stickleback
Stream	Fisheries Resource Value Class	COMMON NAME	Pallid sturgeon	Shovelnose sturgeon	Paddlefish	Goldeye	Mountain whitefish	Kokanee	Cutthroat trout	Rainbow/cutthroat hybrid	Rainbow trout	Brown trout	Brook trout	Arctic grayling	Northern pike	Carp	Minnow	N. Redbelly x finescale dace	Utah chub	Flathead chub	Sturgeon chub	Lake chub	Sicklefin chub	Emerald shiner	Redside shiner	Sand shiner	Brassy minnow	Plains minnow	Plains/silvery minnow	Silvery minnow	Fathead minnow	Longnose dace	River carpsucker	Blue sucker	Smallmouth buffalo	Bigmouth buffalo	Shorthead redhorse	Longnose sucker	White sucker	Largescale sucker	Mountain sucker	Black bullhead	Channel catfish	Stonecat	Burbot	Green sunfish	Pumpkinseed	Bluegill	Smallmouth bass	Largemouth bass	White crappie	Black crappie	Yellow perch	Sauger	Walleye	Iowa darter	Freshwater drum	Mottled sculpin	Brook stickleback
UPPER MISSOURI RIVER DRAINAGE																																																											
Avalanche Creek	4									C																																															C	
Beaver Creek																																																										
Town of Nelson-Mouth	3								U	R	U	U	U																										U																			U	
Headwaters-Town of Nelson	3								U	U	U	R	U																																													U	
Beaver Creek																																																										
National Forest-Mouth	4										P		A																																													C	
S.Fk. Beaver Creek-National Forest	4									U			A																																													U	
1920 Meter Elevation-S.Fk. Beaver Creek	4									C			C																																														
Canyon Creek	4										C	R	C																																													C	
Confederate Gulch																																																										
National Forest-Ditch Head In Section 16	4								C				A																																													C	
Cement Gulch-National Forest	4									U	P	P	A																																														
Cottonwood Creek	4										U	P	C																																													C	
Crow Creek																																																										
Radersburg-Mouth	4						U				U																																																
National Forest-Radersburg	3										C	R	C																																													A	
Hall Creek-National Forest	3										A		C																																													C	
Crow Creek Falls-Begin Gorge	4										U		C																																													U	
Jct. Wilson/Tizer Creeks-Crow Creek Falls	4										U		C																																														
Deep Creek																																																										
Headwaters-National Forest	3								R		C		C																																													U	
National Forest-County Road	4								PE		C	C	U																																													U	
County Road-Mouth	4								PE		U	U	U																																													U	
Dry Creek																																																										
Source-National Forest	3								U		C		C																																													C	
National Forest-Mouth	4								U	P	C		C																																													C	
Duck Creek																																																										
Gold Mines-Irrigation Ditch	4								R		U		C																																													C	
Irrigation Ditch-Mouth	4								U		C	C	A			U																									PE																					
Little Prickly Pear Creek #1	2						U				C	C	U																										U	U																			C	
Little Prickly Pear Creek #2	2						U				C	C	U																										U	U																			C	
Lyons Creek	4										U	P	U																																													C	
McGuire Creek	6										P			~~P~~	~~P~~																																											P	
Missouri River #1																																																										
Canyon Ferry Reservoir-Toston Dam	1						A		P		C	C	P			R			PE	R													U						U	U		U			C	U					R			P					C	
Toston Dam-Three Forks	3						A		PE		C	C	PE			R			PE	U													U						U	U		U				U					R			PE					C	
Missouri River #2	1						C	U	R		A	A				U																							C	C														U		R			C	
Prickly Pear Creek #1																																																										
Begin Private Land-End Private Land	4												C																																														
4.8km Above National Forest-National Forest	2								C				C																																														
National Forest-Clancy Creek	3										C		C																																													C	
Prickly Pear Creek #2																																																										
Clancy Creek-County Road Crossing	3								P		A	A	U																										A	U																			C	
County Road Crossing-Mouth	4										U	U	U																										C	C																				
Sevenmile Creek	4										C	U	U																																													R	
Silver Creek	3							P	C		P	P	P																																													C	

Upper Missouri subbasin (continued)

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	1=outstanding	4=moderate
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A=abundant; C=common; P=present; PE=presence expected but not confirmed; U=uncommon; R=rare

		FAMILY	Sturgeon		Paddlefish	Mooneye	Trout								Pike	Minnow																	Sucker									Catfish			Codfish	Sunfish							Perch				Drum	Sculpin	Stickleback
Stream	Fisheries Resource Value Class	COMMON NAME	Pallid sturgeon	Shovelnose sturgeon	Paddlefish	Goldeye	Mountain whitefish	Kokanee	Cutthroat trout	Rainbow/cutthroat hybrid	Rainbow trout	Brown trout	Brook trout	Arctic grayling	Northern pike	Carp	Minnow	N. Redbelly x finescale dace	Utah chub	Flathead chub	Sturgeon chub	Lake chub	Sicklefin chub	Emerald shiner	Redside shiner	Sand shiner	Brassy minnow	Plains minnow	Plains/silvery minnow	Silvery minnow	Fathead minnow	Longnose dace	River carpsucker	Blue sucker	Smallmouth buffalo	Bigmouth buffalo	Shorthead redhorse	Longnose sucker	White sucker	Largescale sucker	Mountain sucker	Black bullhead	Channel catfish	Stonecat	Burbot	Green sunfish	Pumpkinseed	Bluegill	Smallmouth bass	Largemouth bass	White crappie	Black crappie	Yellow perch	Sauger	Walleye	Iowa darter	Freshwater drum	Mottled sculpin	Brook stickleback
Sixteenmile Creek																																																												
Headwaters-Higgins Reservoir	3										A	U	A																																													C	
Higgins Reservoir-Sixteen	3										A	U	A																																													C	
Sixteen-Maudlow	3						C		C		A	A																										PE	PE																			C	
Maudlow-Mouth	3						A				A	A																										C	C																			C	
Spokane Creek	3									P	P			~~C~~	~~C~~																																											PE	
Stickney Creek	3								R		C		U																																													C	
Tenmile Creek																																																												
National Forest-Road 356	4										C		U																									U	U																			A	
Below Rimini-National Forest	4										U		U																																													C	
National Forest - Mouth	6										P	P	P																																													P	
Trout Creek	3							C		P	U	C																										U																				C	
Unnamed Tributary of Tenmile Creek	6										R																																																
Virginia Creek	4										P	P	C																																													C	
Warm Springs Creek	6											PE																																															
Wegner Creek	6										C																																																
Whiskey Springs	6																		P																																							
Willow Creek	3								P	P	U		C																																													C	
Wolf Creek	3						U		R		C	R	C																										U																			C	
MISSOURI RIVER DRAINAGE - Holter Dam to Belt Creek																																																												
Missouri River #3																																																												
Sand Coulee Creek-Black Eagle	3						C				U	U				C																P						C	C			C		C	P			R		R		R	C					C	
Smith River-Sand Coulee Creek	3						C				U	U				C																P						C	C			P		C	U					R		R	C		U			C	
Cascade Bridge-Smith River	3						C				C	U				C																						C	C					U	U										U			C	
Sheep Creek-Cascade Bridge	1						C				A	U				U						C									C	A						C	C						R		R			R			U		R			C	
Dearborn River-Sheep Creek	1						A		R		A	U				U						U									U	A						C	C						U								U		R			C	
Holter Dam-Dearborn River	1						A	R	R		A	U				U																A						C	C						U								U		U			C	
Missouri River #4																																																											
Black Eagle Dam-Morony Dam	3						U				U	U				U				C											C	C						C	C			U		U			R						U					C	
DEARBORN RIVER DRAINAGE																																																												
Dearborn River																																																												
National Forest-Mouth	3						C				C	C	U																			C						C	C																			C	
Near Headwaters-National Forest	3								U		C		U																																													C	
Flat Creek	4						P				U	U	U																																														
Middle Fork Dearborn River	4										U		U																										P																			C	
Sheep Creek	3						C				C	U	U																									C	C																			C	
South Fork Dearborn River	4										U		U																																														
SMITH RIVER DRAINAGE																																																												
Big Birch Creek																																																												
National Forest-Mouth	4						C		U		U	R	A																																													C	
Near Forks-National Forest	4								U		U		C																																														
Eagle Creek	4								R		C		C																																														
Hound Creek	3						C				C	C	U																																													C	
Newlan Creek																																																												
National Forest-Mouth	4						C		P		U		C																																													C	
Jct Sec 11/12-National Forest	4										U		C																																														C	

448. **Comment**:

a. Page I-3, Table I-1 - On four streams in the Gallatin River drainage, DFWP requested all the remaining unappropriated flow. The table shows flows remaining on these streams after the instream flows are subtracted. Since DFWP requested *all* of the remaining flow for each month of the year, the table should show zero remaining flow at the following: Bridger Creek near Bozeman, East Gallatin River at Bozeman, Rocky Creek near Bozeman, Sourdough Creek near Bozeman. Also, in Table I-1 under the Madison River drainage, the same comments above apply to the following three streams: Beaver Creek near West Yellowstone; Cabin Creek near West Yellowstone; West Fork Madison River near Cameron.

b. Page I-4, under Jefferson River drainage - Black Sand Spring Creek is a Madison River tributary, not a tributary to the Jefferson and the flows listed are not correct. Halfway Creek and Willow Spring Creek flows are not correct. Under the Big Hole River drainage, the flows are not correct for Delano Creek or Rock Creek. Under the Beaverhead River and Red Rock River drainage, the flows for Poindexter Slough are not correct. All these flows are too low. DFWP can provide the correct numbers.

c. Page I-6, under Smith River drainage, the North Fork of Deep Creek is missing from the list.

d. Page I-7, under Marias River drainage, the flows for Badger Creek are not correct (too low).

e. Page I-8, under Musselshell River drainage, the flows for Collar Gulch Creek are not correct (too low).

Response: The following changes have been made to Table I-1.

Table I-1. Average monthly and annual flow (cfs) remaining after requested instream flows are subtracted

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
MADISON RIVER DRAINAGE													
Black Sand Spring Creek													
	0	0	0	0	0	0	2	17	18	4	0	0	3
	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
JEFFERSON RIVER DRAINAGE													
Halfway Creek													
	0	0	0	0	0	0.1	4.4	18.9	17.4	2.8	0	0	3.3
	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~	~~3.3~~
Willow Spring Creek													
	1	0	0	0	0	0	1	5	8	5	2	2	2
	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
BIG HOLE RIVER DRAINAGE													
Delano Creek													
	0.2	0.1	0.1	0	0	0	0.2	1.6	2.9	1.2	0.5	0.3	0.6
	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~	~~0.6~~
Rock Creek													
	3.8	2.4	1.1	0.8	0.7	1.0	4.4	28	51.5	21.7	9.8	5.4	10.7
	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~	~~10.7~~
BEAVERHEAD RIVER DRAINAGE													
Poindexter Slough													
	18	16	9	11	9	9	18	28	28	23	16	16	16
	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
SMITH RIVER DRAINAGE													
North Fork Deep Creek													
	1.1	0.7	0.4	0.2	0.2	0.3	1.8	11.7	13.8	4.7	2.1	1.4	3.2
MARIAS RIVER DRAINAGE													
Badger Creek													
	22	12	5	0	2	6	60	362	374	111	37	24	84
	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~	~~91~~
TETON RIVER DRAINAGE													
Spring Creek													
	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0	0.1	0.2	0.3	0.2
MUSSELSHELL RIVER DRAINAGE													
Collar Gulch													
	0.2	0.2	0	0	0	0.1	0.8	3.2	5.0	0.8	0	0	0.8
	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~	~~0.8~~

453. **Comment**: On page K-13, Table K-7, the City of Great Falls's water system is now 100 percent metered.

Response:

Table K-7. Municipal water system characteristics

Municipal Requests	Water Distribution Systems with Substantial Leakage	Percent of Service Metered	Unmetered Service
Great Falls		~~96%~~ 100%	

DNRC STAFF CHANGES TO THE DRAFT EIS

The following section presents changes made to the draft EIS by DNRC staff during its review of public comments. Deleted material is shown with lines through it. New material is shaded.

The following changes to the summary in the draft EIS were made in the final EIS.

SUMMARY

In July 1991, the Montana Department of Natural Resources and Conservation (DNRC) released its draft environmental impact statement (EIS) for Water Reservation Applications above Fort Peck Dam. Informational meetings and public hearings on the draft EIS were held in 10 Missouri basin communities from August 5 through August 7. The public had until September 2 to comment on the draft EIS, with this deadline later extended to September 16. This final EIS responds to comments and questions pertaining to the draft EIS and summarizes and updates the draft.

MISSOURI RIVER WATER RESERVATION STATUTE

In 1985, the Montana Legislature directed DNRC to begin a basinwide water reservation proceeding for the Missouri River basin above Fort Peck Dam. The legislature felt that implementation of a water reservation procedure would encourage more coordinated development of the water resources in the basin and would help form a strong and unified basis for protecting Montana's share of the Missouri River water from downstream states. Reservations granted in this process have a priority date of July 1, 1985. Under Montana water law, reservations allow for existing or future consumptive uses of water and for maintaining instream flows to protect aquatic life, recreation, and water quality. Only public entities such as local governments, conservation districts, and state and federal agencies can apply for and hold water reservations. DNRC was assigned by statute to coordinate the process and to provide technical and financial assistance to conservation districts and municipalities in preparing their applications. The Board of Natural Resources and Conservation (Board) must reach a decision on water reservation applications above Fort Peck Dam by July 1, 1992.

APPLICATIONS

DNRC received 40 reservation applications. Eighteen municipalities applied for 34,689 acre-feet per year to meet future growth. Eighteen conservation districts requested 388,137 acre-feet per year, primarily for ~~220~~ 219 proposed irrigation projects covering ~~151,571~~ 154,604 acres. The Montana Department of Health and Environmental Sciences (DHES) applied to reserve half the average annual flow at four points on the Missouri River (near Toston, Ulm, Virgelle, and Landusky) to maintain dilution of arsenic in the river water. The Montana Department of Fish, Wildlife and Parks (DFWP) applied to reserve instream flows on 283 streams or stream reaches, one lake, and one wetland, to protect fish, wildlife, recreation, and water quality. The U.S. Bureau of Land Management (BLM) requested instream flows on 31 streams for fish, wildlife, recreation, and to maintain channel form. The U.S. Bureau of Reclamation (BUREC) applied to reserve a maximum of 280 cfs, up to a yearly total of 89,000 acre-feet from the Missouri River. This water would be diverted into the Milk River basin to relieve water shortages and provide for some new irrigation.

EIS PROCESS

~~The Montana Environmental Policy Act requires preparation of an environmental impact statement (EIS) for major actions of state government that have the potential to affect significantly the human and natural environment. This EIS examines the environmental, social, and economic impacts of the proposed reservation requests. In the summer of 1989, DNRC held 10 public meetings at different locations throughout the basin to identify important issues for analyses and inclusion in the EIS. An environmental assessment was prepared for each reservation application to provide the basis for the analyses and conclusions contained in this EIS. DNRC also developed a computer model of the Missouri River Basin to assess physical and legal availability of water. This draft EIS is based on the above information and research and analysis by DNRC staff and consultants. Following release of the draft EIS, there will be a 60-day period during which time written comments on the draft EIS can be submitted to DNRC. DNRC also will hold public meetings across the basin to receive comments on the draft EIS. The final EIS will address all substantive comments responding to the draft EIS.~~

The Montana Environmental Policy Act (MEPA) requires preparation of an environmental impact statement for major state government actions that have the potential to significantly affect the human and natural environment. An EIS examines the environmental, social, and economic impacts of the proposed action and is generally prepared in two phases—a "draft" and "final" EIS. Because the Missouri basin water reservation proceeding is a major state action that could have substantial effects on the environment, an EIS was prepared.

In the summer of 1989, DNRC held 10 public meetings at different locations throughout the basin to identify important issues for analyses and inclusion in the draft EIS. DNRC also developed a computer model of the Missouri River basin to assess the availability of water. The draft EIS included discussion of issues raised by meeting participants, along with analysis based on the computer modeling. Further information, research, and analysis was provided by DNRC staff and consultants. The draft EIS was distributed in July 1991.

Information meetings followed by hearings were held in 10 Missouri basin communities during August 5, 6, 7, and 8, 1991, to take comments and questions on the draft EIS (Table S-1). Distribution of the draft EIS was followed by a 60-day comment period during which DNRC accepted written comments on the draft EIS. This comment period was extended two weeks to end on September 16, 1991. DNRC received a total of 86 written comments and letters in response to the draft EIS. This final EIS was then prepared to respond to comments and questions pertaining to the draft, and to summarize and update information in it.

Table S-1. Public participation in meetings held to take comments on draft EIS

Meeting location	Number of people attending	Number of people making comments on draft EIS
Helena	13	3
Roundup	10	9
Big Sandy	2	0
Great Falls	13	2
Ennis	2	0
Valier	7	1
Lewistown	12	3
Bozeman	29	3
Glasgow	9	0
Dillon	101	14

COMMENTS ON DRAFT EIS

Major issues raised in the comments pertained to the availability of water for the reservations; technical aspects of water law; appropriateness of a Board decision prior to completion of adjudication; how the reservations would affect water quality, particularly arsenic and sediment; appropriateness of methods used to determine instream flow requests and impacts to fisheries; and how the value of water for instream flow was determined. Many commenters indicated support or opposition to one reservation or another.

NEW INFORMATION

MPC proposes to upgrade several of its Missouri River hydroelectric generating facilities, increasing generating capacity by 68 MW. Effects of each alternative on hydroelectric generation at the upgraded facilities were calculated and found to be small.

Since publication of the draft EIS, the U.S. Fish and Wildlife Service has received a petition to list the fluvial (stream-dwelling) arctic grayling as an endangered species and to designate all waters in its former range as critical habitat. The only known population of fluvial arctic grayling in the lower 48 states today is in the Big Hole River drainage.

ALTERNATIVES

To address the full range of potential impacts and options available to the Board, DNRC selected four alternatives to analyze in the draft EIS. They are: the Consumptive Use, Instream, Combination, and No Action alternatives. Two additional alternatives—the Water Quality and Municipal alternatives—were developed and analyzed in the final EIS in response to requests by a number of commenters.

DNRC also recalculated the benefits and costs of each alternative after refining assumptions about the value and timing of return flows, and after finding an error in Table 6-41 of the draft EIS.

~~Municipalities were included under all three alternatives and given first priority because of the relatively small amount of water requested for that purpose.~~

Municipal reservations were given highest priority under all but the No Action and Water Quality alternatives because of the relatively small amount of water requested for municipal use.

The Consumptive Use Alternative emphasizes the use of water for irrigation and municipal purposes. First preference in this alternative goes to municipalities, followed by proposed irrigation projects, and then instream uses. ~~All irrigation projects proposed in the reservation applications were included in this alternative.~~ This alternative would include water reservations for all irrigation projects proposed in the reservation applications.

The Instream Alternative gives first priority to municipal uses, but emphasizes instream ~~reservations~~ uses for the protection of fish, wildlife, recreation, and water quality. Irrigation would have third priority.

To some extent, the Combination Alternative is similar to the Consumptive Use Alternative in that it gives first preference to municipalities, second to proposed irrigation projects, and third to instream uses. It differs primarily in that proposed irrigation projects are only included if they are at least marginally economically and financially feasible ~~at least 50 percent of the time~~. A few other projects were excluded or reduced in size on the basis of concerns about land use impacts or other environmental considerations.

The Water Quality Alternative includes only reservations for requested instream flows and, therefore, would not have any adverse effects on water quality. This alternative was developed in response to comments on the draft EIS.

The Municipal Alternative also was developed in response to comments on the draft EIS, which suggested benefits would be maximized if an alternative were developed that included all instream and municipal requests, but no new irrigation projects. Under this alternative, first preference is given to municipalities and second to instream reservations. No irrigation projects are included.

Under the No Action Alternative, DNRC describes trends that might unfold through the year 2025 if no ~~water is reserved for any purpose~~ reservations are granted.

BOARD AUTHORITY

The Board can grant, modify, or deny any or all of the reservation requests. Applicants must establish to the satisfaction of the Board the following four criteria:

a. the purpose of the reservation;
b. the need for the reservation;
c. the amount of water necessary for the reservation; and
d. that the reservation is in the public interest.

Besides these criteria, the Board also must ensure that the reservation applicants make progress toward development of the proposed use with reasonable diligence and that no reservations are granted that would adversely affect senior water rights. To make its decision, the Board will have to abide by the decision criteria described in Chapter Seven of the draft EIS and rely on information in the applications, draft and final EIS, individual environmental assessments, and on testimony presented at the contested case hearing.

IMPACTS UNDER CONSUMPTIVE USE, COMBINATION, ~~AND~~ INSTREAM, MUNICIPAL, AND WATER QUALITY ALTERNATIVES

GENERAL CONSIDERATIONS

~~Impacts on the existing environment are generally greatest under the Consumptive Use Alternative, less under the Combination Alternative and least under the Instream Alternative. Some proposed projects included in all three alternatives would have substantial impacts. Impacts were not assessed for some of the larger projects where information was not required nor available in the applications. A separate environmental review may be required before some of these projects could be constructed.~~

Alternatives listed in order of decreasing impacts to the existing environment are the Consumptive Use Alternative, Combination Alternative, Instream Alternative, Municipal Alternative, and Water Quality Alternative. Some proposed consumptive use projects included in all but the Water Quality Alternative would have substantial impacts. Some impacts were not assessed for large projects where information was not available. A separate environmental review might be required before some of these projects could be constructed.

WATER QUANTITY AND DISTRIBUTION

Many rivers, streams, reservoirs, and groundwater systems have been altered by existing water uses and could be further modified by any consumptive use project developed through the use of reservations. ~~On some~~ Some streams ~~there is not enough~~ have too little water in dry years to satisfy all existing water users. Impacts to streamflows would be greatest under the Consumptive Use Alternative which would reduce flows substantially in the Jefferson, Smith, Sun, Marias, and Teton rivers and in at least a dozen smaller tributary streams. In several of the rivers and streams, late summer streamflows would be reduced to zero or near zero during dry years. ~~Impacts to streamflows would be less under the Combination Alternative and least under the Instream Alternative.~~ Streamflows would decrease less under the Combination Alternative than under the Consumptive Use Alternative. Streamflow reductions would be even less under the Instream Alternative, and only minor under the Municipal Alternative. Flows would not be affected under the Water Quality Alternative.

LEGAL WATER AVAILABILITY

By law, water reservations cannot adversely affect the amount of water legally available to holders of water rights with a priority date earlier than July 1, 1985. However, if an existing water right user wishes to change the point of diversion, place of use, purpose of use, or place of storage, all senior and junior water right holders, including those with water reservations, have a right to object to the change if they feel that the exercise of their water rights would be adversely affected. This same legal right allows holders of water reservations to object to water right claims submitted in the statewide adjudication proceeding. Holders of water reservations, like all other water right holders, may seek relief from the district court to protect their water rights.

While water may be physically available for a reservation at the point of diversion, it may already be appropriated by a water user downstream. Existing water users such as irrigators, Montana Power Company (MPC), BUREC, BLM, Indian tribes, and the Corps of Engineers already claim most of the flow in the Missouri River and its tributaries. The exact amount of water legally available for future consumptive appropriation, if any, will not be known for some time. The statewide water rights adjudication process will determine the size and extent of these water rights. The Board will need to find that existing water rights would not be adversely affected by the proposed reservations.

Canyon Ferry Dam was built to provide water for consumptive uses, primarily for irrigation, while at the same time maintaining the level of hydropower production at MPC's downstream facilities. Soon after Canyon Ferry Dam went into operation, releases from the reservoir increased MPC's downstream electricity generation by an annual average of 106 gigawatt-hours (1 gigawatt = 1,000 megawatt-hours) (GWh) above the pre-Canyon Ferry level. As more water was consumed for other purposes, the increase above the 1955 level decreased to an average of 84 GWh per year by 1986, and would decrease further to an average of 54 GWh per year under the Consumptive Use Alternative. In the two lowest power years in 10 under the present operating regime, MPC would receive no additional benefits from the reservoir at either the 1986 level of irrigation development or under the Consumptive Use Alternative. ~~However,~~ The problem of high arsenic concentrations in the Missouri River drainage still must be addressed before BUREC will market water stored in Canyon Ferry Reservoir for consumptive uses (see Water Quality).

The Blackfeet Tribes have substantial federal reserved water right claims on the Marias River and its tributaries, with a priority date of May 1, 1888. This special class of water rights might ~~affect future~~ impact use of water reservations and ~~many~~ existing water users.

WATER QUALITY

Water reservations for consumptive use would cause a decline in water quality in some streams and groundwater systems. Higher concentrations of nutrients, pesticides, sediments, and salts would be noticeable in some waters, but in most instances the increases would be minor. Short-term increases in sediments would result from construction of reservoirs and diversion structures.

Arsenic concentrations exceed the federal and state instream standard in the Madison and Missouri rivers in Montana. These concentrations also exceed the federal drinking water standard in the Madison River and the portion of the Missouri River upstream from Toston Dam. Arsenic is a known carcinogen. EPA's standard for carcinogens is based on a risk level that would result in one case of skin cancer per million people. Based ~~on this standard and assumptions~~ on arsenic concentrations in the Missouri River, the EPA standard, and assumptions made by EPA in deriving the standard, the risk of skin cancer from arsenic is as high as one case per 77 people at West Yellowstone, and drops to about one case in 10,000 people near Landusky. At Toston, the risk of cancer is about one case per 666 people.

Reservations that lead to consumptive water use in the Missouri River basin could increase the concentration of arsenic in the Missouri River and adjacent groundwater systems. Consequently, the risk of skin cancer for people who rely on Missouri River water for drinking would increase unless the arseni is removed through special treatment. Such treatment is expensive and requires extensive processin facilities. Proposed irrigation projects diverting wate from the Madison River into the Gallatin drainag and from the Missouri River into the Milk drainag would increase arsenic levels in the Gallatin an Milk rivers. Instream reservations would not chang water quality ~~but may~~ and would not be adequate t preserve flows for ~~arsenic dilutions~~ dilution of arsenic to meet EPA standards.

SOILS AND STREAM CHANNEL FORM

In general, reservations that would result in th conversion of rangeland to irrigation would affec soils through the loss of organic matter, reduce water holding capacity, and increased susceptibilit to erosion. These effects would be offset somewha once an alfalfa crop is established. Where reservations convert dry cropland to irrigation, soil structure will improve, erosion will decrease, and nitroge and organic fertility will increase. Forty-thre projects might have substantial soil impacts an these are identified in Chapter Six of the draft EIS Other effects of consumptive use projects on soils ar generally minor.

Impacts to stream channels generally would b minor. In some instances, consumptive water use could decrease channel capacity by increasing th deposition of sediment. Instream reservations woul not change existing stream channel forms.

LAND USE

Proposed irrigation reservations would conver nonirrigated cropland, pasture, and rangeland t irrigated fields. The amount of newly irrigated cropland would increase in the basin by about ~~24~~ 1 percent (~~208,000~~ 150,248 acres) under the Consumptive Use Alternative, ~~15~~ 9 percent (~~129,00~~ 77,759 acres) under the Combination Alternative and ~~5~~ 4 percent (~~40,000~~ 36,775 acres) under th Instream Alternative. No increases would occur under the Municipal or Water Quality alternatives Forty-two irrigation projects may have other substantial land-use impacts and these are identified i the draft EIS. Other land use impacts are generall minor.

FISH AND AQUATIC HABITAT

Low flow conditions already stress gamefis populations and aquatic habitat on some rivers an streams in the basin. Further consumptive use would generally worsen conditions on these rivers and streams. Streams most severely affected by the proposed consumptive use reservations include the Jefferson River near Waterloo and Three Forks, the Boulder River above Cold Springs, the Marias River, the lower portions of the Sun and Teton rivers, and eight tributaries. Streams where there would also be impacts although the effects could be less include the Gallatin, Missouri, Judith, Dearborn, and Smith rivers and seven smaller tributary streams. Stored water could be released from Tiber Reservoir to offset most water depletions in the lower Marias River. Reservations for instream flows would help maintain the existing aquatic habitat and fisheries.

The effects of flow reductions on the pallid sturgeon, a federally listed endangered species, are not known. The arctic grayling has been proposed as a candidate for listing as an endangered species. Nearly all reservations for consumptive use are located downstream from the present range of the grayling.

It is possible that four of the proposed storage projects could support a fishery. On large irrigation projects, fish could be killed in the diversion structures, though this could be minimized through proper design.

WILDLIFE

Proposed irrigation projects could affect wildlife by altering habitat. Thirty-six irrigation projects would convert native grassland to irrigated cropland on big game winter range and would reduce the amount of native forage available to wintering elk and deer. Losses of winter range could stress wildlife during the winter and early spring and increase depredation on crops and hay. DFWP has identified 70 proposed irrigation projects with a high potential for crop damage from wildlife. Most of these projects are near or within existing winter ranges.

Birds of prey (raptors), waterfowl such as ducks and geese, and aquatic mammals such as mink and river otter could be affected by consumptive use reservations. However, in most cases, site specific information is not available to determine the extent of the effect, if any. Grouse and birds of prey would be affected by local disturbance during nesting and brood rearing periods. Reduced streamflows would make waterfowl more vulnerable to predation and also would limit food supplies for aquatic mammals, which would render them more susceptible to predation.

VEGETATION

Impacts to vegetation would result from replacement of natural plant communities with agricultural crops, inundation of riparian and upland plant communities by reservoirs, reduced stream flows, and increased proliferation of noxious weeds. However, it is difficult to predict the level of impacts on riparian and wetland plant species such as cottonwoods, sedges, rushes, and dominant tree species. No Montana plants are federally listed as threatened or endangered species. Probably the most significant vegetation effect is the increased risk of spreading noxious weeds.

HISTORICAL, ARCHAEOLOGICAL, AND PALEONTOLOGICAL SITES

Proposed consumptive use reservations would affect 60 known historical, archaeological, or paleontological sites. Most sites are located on private land where formal evaluation is not required to determine if some sites might be eligible for listing on the National Register of Historic Places.

STORAGE

Reservations may reduce water available for future storage projects. Reservations generally would not preclude storage of spring runoff flows, but might make some storage projects less economically feasible. Existing water rights could be a greater constraint to the development of new storage than water reservations. Development of consumptive use reservations would slightly decrease reservoir levels in Canyon Ferry, Fort Peck, and Tiber reservoirs. The reservation applications include 15 water storage projects, and together they would store a relatively small amount of water.

RECREATION

Instream reservations would help maintain streamflows on streams and rivers that are important to recreation and tourism. Recreational use of water in the Missouri River Basin in Montana totaled over 2 million recreation days in 1989. About 61 percent of the total water-based recreation use is on rivers and streams and 39 percent on reservoirs. The most important recreational resources in the basin from an economic perspective are the streams in the Headwaters Subbasin such as the Beaverhead, Big Hole, Gallatin, and Madison rivers. The total net economic value of water-based recreation in the basin above Fort Peck Dam is $144 million per year.

~~Recreational use could decline under all three alternatives as flows decrease in rivers and streams.~~ Recreational use could decline under all alternatives that include consumptive use. The effects would become more severe as additional water is withdrawn from streams that already have low flows during dry years, such as the Gallatin, Jefferson, Boulder, Smith, Dearborn, Sun, Teton, Judith, and Musselshell rivers, Belt Creek, and the Marias River above Tiber Reservoir.

Estimated recreational instream values range from $35 an acre-foot ~~per year~~ on headwater rivers and streams during July and August to $2 an acre-foot ~~per year~~ on Middle Missouri and Marias/Teton subbasin streams during the rest of the year. Estimated recreation losses are ~~$3,198,000~~ $3,754,000 per year under the Consumptive Use Alternative; ~~$1,621,000~~ $1,616,000 per year under the Combination Alternative; ~~$310,000~~ $307,000 per year under the Instream Alternative; and $3,930 per year under the Municipal Alternative. No recreation losses are expected under the Water Quality Alternative.

HYDROPOWER

Consumptive use of water under the requested reservations eventually would increase the cost of electricity to ratepayers by: (1) increasing the use of electricity to operate municipal and irrigation pumps, and (2) decreasing streamflows that are used to generate electricity~~, and (2) requiring production of additional electricity~~. These two actions would require production of replacement power from new sources that would be considerably more expensive than existing power supplies. The total monetary impact to ratepayers would range from ~~11.5~~ $11.0 to ~~30.4~~ $29.2 million per year under the Consumptive Use Alternative; ~~4.8~~ $4.7 to ~~12.8~~ $13.4 million per year under the Combination Alternative; ~~1.7~~ $1.4 to ~~5.1~~ $4.4 million per year under the Instream Alternative; and $0.09 to $0.5 million per year under the Municipal Alternative. The Water Quality Alternative would not directly affect ratepayers. The cost of replacing power used under the Consumptive Use Alternative (in excess of revenue received for irrigation and municipal pumping~~ to municipalities~~) would range from ~~5.9~~ $1.8 to ~~19.3~~ $11.0 million per year; ~~2.8~~ $1.0 to ~~8.4~~ $6.1 million under the Combination Alternative; ~~1~~ $0.4 to ~~4~~ $2.4 million under the Instream Alternative; and $.09 to $0.52 million under the Municipal Alternative.

AGRICULTURE

Development of irrigation projects in the basin under any alternative would have a ~~positive~~ small beneficial effect on jobs, personal income, taxes, and agricultural sales. Benefits would be greater in the Marias/Teton and Middle Missouri subbasins than in the upper Missouri and Headwater subbasins. About 30 jobs would be created in the basin under the Instream Alternative, about 53 under the Combination Alternative, and about 106 under the Consumptive Use Alternative. No new jobs would be created in the agricultural sector under the Municipal or Water Quality alternatives. Total personal income in the basin would increase between $1,749,723 in the Instream Alternative and $6,066,878 per year under the Consumptive Use Alternative. County tax receipts would increase between $59,563 for the Instream Alternative and $158,440 per year under the Consumptive Use Alternative. Agricultural sales would increase between 1.0 percent and 3.5 percent. Agricultural sales, personal income, and county tax receipts would not increase under the Water Quality Alternative.

SOCIAL EFFECTS

The reservations would not noticeably change the social character of communities in the Missouri River basin. The agriculture community would remain stable, and the recreation and tourism-related services would ~~still~~ constitute a growing segment of the ~~local~~ basin economy.

NO ACTION ALTERNATIVE

If the Board were to deny all reservation applications, consumptive water users could still apply through the water use permitting process to appropriate water for beneficial uses. If most or all direct flows are appropriated by water users such as MPC and irrigators, a potential user could buy an existing water right and change the use. Municipalities could condemn existing water rights to meet future needs.

~~Irrigated agriculture probably would remain stable. Some new irrigation projects would be built in the basin. This new development probably would be offset by the amount of irrigated land going out of production because of low farm prices brought on by high yields on more productive land.~~

If instream reservations are not granted, instream flows in many streams and rivers would not be protected by a water right. In some instances, increased consumptive uses could lead to streams becoming very low or going dry, resulting in adverse impacts to water quality, aquatic life, recreation, and wildlife. Murphy water rights, large hydropower water rights, and federal and state water quality standards for arsenic would provide some level of instream flow protection in some streams and rivers.

~~If and when Missouri River flows are divided among basin states, Montana claims for future use would be stronger with consumptive use reservations in place.~~

If present trends hold, few large storage projects will be built over the next 25 years. Emphasis during this period ~~will~~ probably will be on rehabilitation and enlargement of existing facilities as defined in the state water plan.

BOARD DECISION CRITERIA

The decision of whether to grant, modify, or deny the reservation applications rests with the Board, which must abide by several criteria which are discussed below. The ability of the requested reservations to meet these criteria is examined in DNRC's research and analyses of the reservation applications, as explained in Chapter Seven of the draft EIS. These results are preliminary and do not represent ~~recommendations~~ conclusions on whether any reservation request satisfies any of these criteria. Such determinations are made by the Board.

QUALIFICATION AND PURPOSE

All those who applied for reservations were found to be qualified to reserve water through the Missouri River Basin water reservation proceeding. The purpose for all reservation requests are beneficial uses under Montana law.

NEED

A water reservation is needed if "there is a reasonable likelihood that future instate or out-of-state competing water users would consume, degrade, or otherwise affect the water available for the purpose of the reservations" or if "there are constraints that would restrict the applicant from perfecting a water permit for the intended purpose of the reservation." All applicants claimed a need to reserve water. Conservation districts want to secure water for agricultural production before the water is appropriated by other users in Montana or by downstream states. They also want to have the option to develop this water when the economic climate improves. Municipalities want to appropriate water to meet future growth ~~when available water supplies are diminishing~~ in the basin. DFWP and BLM want to have secure instream flows to protect fish, wildlife, recreation, and water quality. DHES wants to secure instream flows to protect the public from increased risk of cancer from arsenic concentrations which are already high. BUREC intends to divert Missouri River water to reduce shortages in the Milk River basin.

AMOUNT

The Board must determine the amount needed to fulfill the purpose of the reservations. This amount must be based on accurate and suitable measuring methods and determinations that no reasonable cost-effective measures could be taken within the reservation term to increase efficiency and lessen the amount of water required.

Conservation districts' requests are based on recorded crop requirements and efficiency of proposed irrigation systems. Most of the projects were designed for efficient sprinkler irrigation.

The three agencies that requested instream flows used various methods for determining their requested water reservations. DFWP employed several methods, but ~~used most frequently~~ primarily used the Wetted Perimeter Inflection Point Method (WETP). This method provides an indication of streamflows necessary to maintain aquatic habitat in riffle areas. BLM used the same wetted perimeter method to determine yearly minimum flows, but also used channel geometry methods developed by the United States Geological Survey (USGS) for determining flows necessary to maintain channel stability. ~~DHES feels~~ DHES's position is that any new consumptive use development would increase ~~the risk to cancer based on the higher arsenic concentration in the Missouri River~~ arsenic concentrations and the consequent cancer risk from Missouri River water, and that all remaining unappropriated flows are needed to protect public health. Under the law, however, DHES can request no more than half the average annual flow on gauged streams. This is the amount DHES requested at four points on the Missouri River. ~~DHES, however, is limited by statute to request half the average annual flow on gauged streams and this is the amount requested at 4 points on the Missouri River.~~

Municipalities requested enough water to service estimated population growth to the year 2025. The amount of water needed was normally calculated by multiplying the per capita rate of consumption times the estimated population. Per capita use rates were generally based on actual use requirements for each community. ~~Increased population multiplied by per capita rate of consumption was used to calculate the total amount requested in the applications. The 1990~~ Long-term census information indicates that 11 of the 18 municipal projections of population growth, and the associated amounts of water requested, may be higher than actually ~~will~~ would occur.

~~BUREC based the amount of its request on supplemental water requirements for existing irrigated lands along the Milk River and on the Fort Belknap Indian Reservation, and the water necessary for full-service irrigation of lands on the Rocky Boy's Indian Reservation and lands adjacent to the proposed canal.~~ BUREC based the amount of its request on estimated supplemental water requirements for land that is already irrigated when water is available along the Milk River and on the Fort Belknap Indian Reservation, and the water needed to irrigate land that is not now irrigated on the Rocky Boy's Indian Reservation and along the proposed canal. Present and future water conservation measures will relieve some of the water shortages in the basin. Since it is not known how much water will be saved through conservation nor the actual amount the Tribes will need to satisfy their federal reserved water rights, it is difficult to determine the adequacy of the amount that BUREC requested in its application for the Virgelle diversion project.

PUBLIC INTEREST

The public interest criteria require in part that the benefits of the reservation exceed the costs. Reservations for municipal water supplies and irrigation would provide monetary benefits to basin communities. However, they would ~~have~~ result in costs by ~~decreasing streamflows~~ causing streamflow reductions which could adversely affect recreation and hydropower production. Reservations for consumptive uses also would ~~use additional~~ increase the electrical power load, which eventually would require the production of ~~higher cost~~ electricity from new sources. New sources of power tend to cost more than existing power sources. Therefore, decreased hydroelectric generation combined with increased power loads would raise electricity costs for all users. ~~The value of an acre-foot of water for instream flow is based on recreation and electricity production.~~ Table S-1 identifies the ~~total~~ net benefits and costs of water uses under the ~~three~~ five alternatives. Total net benefits per year are greatest under the Instream Alternative ($327.17 million), slightly less under the Municipal Alternative ($321.98 million) and Combination Alternative ($305.13 million), considerably lower under the Consumptive Use Alternative ($151.30 million), and zero under the Water Quality Alternative.

~~Net benefits per year are greatest under the Combination Alternative ($351.8 million), slightly less under the Instream Alternative ($338.5 million) and considerably lower under the Consumptive Use Alternative ($152.7 million).~~

~~Municipal water developments have benefits that exceed costs by $341.3 million because of the small amount of water consumed and the high value of this use under all three alternatives (Tables S-2). In contrast, proposed irrigation projects consume large amounts of water. Total costs associated with the depletions would exceed total benefits by $188.6 million per year under the Consumptive Use Alternative, $27.2 million per year under the Combination Alternative and $2.8 million per year under the Instream Alternative (Table S-2).~~

The value of an acre-foot of water for instream and consumptive uses can be compared when reservations for the two uses are both requesting the same water. ~~Sixty-two proposed irrigation projects would value an acre-foot of water at a greater level than the instream values, and 157 proposed irrigation projects would value water less than the instream values. The value of an acre-foot of water for all municipal reservations exceeds the instream flow and proposed irrigation project values.~~ Instream values include the value of water used for recreation, plus the value of water used for hydroelectric generation. In determining the value of water for the proposed irrigation projects, DNRC examined three ways the timing of return flows affect the value of water. DNRC assumed that replacement power used to replace that lost due to reduced flows and to satisfy increased power loads for consumptive use projects would cost between 5 and 10 cents/kWh.

At least 10 and as many as 59 of the 219 proposed irrigation projects would have a value per acre-foot of water that is greater than the value of water used for instream purposes, given a 5 cent/kWh power cost. The value of water for at least 1 and as many as 4 of the proposed irrigation projects would be greater than the value of water used for instream purposes, given a 10 cent/kWh electricity cost. The estimated value of an acre-foot of water for all municipal reservations exceeds the estimated value for instream flow and proposed irrigation projects. Instream flow values are greatest in the Headwaters subbasin where the recreation value is the highest and where each acre-foot of water can be passed along to be used to generate hydroelectricity at downstream hydropower facilities. Instream values decline progressively with distance downstream, but the value of water for irrigation remains more consistent throughout the basin.

~~On each stream or stream reach, the number of requests that will give the greatest net benefit is based, in part, on the amount of water available. However, water availability may not be definitely known before the Board acts on the reservation requests.~~

On each stream or stream reach, the potential net benefit is based on the assumption that water is available. However, in some instances, water may not always be available.

RECOMMENDATIONS

DNRC is not recommending a course of action to the Board. The Board has appointed a hearings examiner to conduct a formal contested case hearing which will begin in February 1991. Based on information in the applications and the EIS and on testimony at the hearing, the hearings examiner will present findings and recommendations to the Board. The Board then has until July 1, 1992, to make its decision on the water reservation applications.

Table S-2. Economic benefits and costs under five alternatives ($ million)[a]

	Consumptive	Instream	Combination	Municipal	Water Quality
Irrigation	$134.1	$38.7	$112.6	$0.00	$0.00
Municipal	$324.0	$324.0	$324.0	$324.0	$0.00
Recreation	-$78.3	-$6.4	-$33.7	-$0.1	$0.00
Hydropower production	-$190.3	-$20.8	-$76.6	$0.1	$0.00
Replacement power	-$38.1	-$8.3	-$21.2	-$1.8	$0.00
TOTAL	$151.3	$327.2	$305.1	$322.0	$0.00

[a] Positive numbers represent net benefits and negative numbers represent net costs.
All figures are the value today of 70 years of future impacts based on a 4.6 percent real discount rate.

~~Table S-1. Benefits and costs of water use under three alternatives~~

	~~($ million)[a]~~		
	~~Consumptive Use~~	~~Instream~~	~~Combination~~
~~Irrigation~~	~~134.1~~	~~38.7~~	~~119.9~~
~~Municipal~~	~~343.2~~	~~343.2~~	~~343.2~~
~~Recreation~~	~~-70.3~~	~~-6.7~~	~~-35.7~~
~~Hydropower Production~~	~~-213.4~~	~~-27.6~~	~~-87.3~~
~~Replacement Power~~	~~-40.9~~	~~-9.1~~	~~-18.0~~
~~Total~~	~~152.7~~	~~338.5~~	~~351.8~~

~~a Positive values represent benefits and negative values represent costs.~~

~~Table S-2. Benefits and costs of municipal use and irrigation use under three alternatives~~

	~~($ million)[a]~~		
	~~Consumptive Use~~	~~Instream~~	~~Combination~~
~~Irrigation~~			
~~—benefits~~	~~134.1~~	~~38.7~~	~~119.9~~
~~—costs~~	~~-322.7~~	~~-41.5~~	~~-139.1~~
~~—net~~	~~-188.6~~	~~-2.8~~	~~-27.2~~
~~Municipal~~			
~~—benefits~~	~~343.2~~	~~343.2~~	~~343.2~~
~~—costs~~	~~-1.9~~	~~-1.9~~	~~-1.9~~
~~—net~~	~~341.3~~	~~341.3~~	~~341.3~~

~~a Positive values represent benefits and negative values represent costs.~~

The following change was made on pages 44, 48, 51, and 53.

Source: USGS 1989~~b~~

The following change was made on page 61.

Table 4-12. Headwaters benefits to MPC's seven mainstem facilities from Canyon Ferry Reservoir (annual GWh)

Frequency of Occurence[a]	Column A 1955 LOD[b] Pre-CF[c]	Column B 1955 LOD Post-CF	Column C 1986 LOD Post-CF	Column D Headwater Benefits at 1955 LOD (Column B-ColumnA)	Column E Headwater Benefits at 1986 LOD (Column C-Column A)	Power Loss Between 1955 and 1986 (Column D-Column E
2 years in 10	2,145	2,291	2,260	146	115	~~21~~ 31

The following changes were made on page 69.

ARSENIC

Arsenic, a trace element known for its short-term and long-term health effects, is a carcinogen. Recently it has come under increasing regulatory attention from both EPA and DHES. A confusing aspect of arsenic involves two apparently contradictory water quality standards. Based on human health studies, federal drinking water standards limit arsenic to 50 micrograms per liter (µg/L or parts per billion) in treated water supplies. This standard, initially adopted in 1946, is being reviewed by EPA. It is likely that the concentration allowed in drinking water will be significantly reduced, but to what level is not known at this time. At the other end of the spectrum, the Board of Health and Environmental Sciences in 1990 adopted an instream standard ~~that is~~ of 2.2 nanograms or less based on EPA's one-case-per-million risk level for carcinogens. ~~In contrast to the 50 micrograms per liter (parts per billion) standard for drinking water, this standard will not allow activities that increase arsenic in surface water with an arsenic concentration exceeding 20 nanograms per liter (parts per trillion).~~ At the time this 2.2 nanogram per liter standard was adopted, it was felt that it would not allow arsenic concentrations in surface water to exceed a level which would cause more than one additional cancer case per one million people. Recent research indicates that a concentration of 20 nanograms per liter more accurately reflects the cancer risk rate of one case per million people. EPA has raised its guidelines from 2.2 to 20 nanograms per liter, but BHES has not yet changed Montana's standard.

Table 4-18. Summary of arsenic concentrations in the upper Madison and Missouri rivers

	Arsenic concentration (µg/L) Minimum	 Median	 Maximum
Missouri River at Toston	10	30	100[a]
below Canyon Ferry Dam	23	28	34
near Landusky	~~1~~ 7	~~2~~ 14	52

[a] Dissolved arsenic concentration

Notes: µg/L = parts per billion (ppb)

1 part per billion exceeds BHES standard by ~~50~~ roughly 500 times.

Except where noted, all values are total arsenic concentration.

Source: USGS 1987

The following changes were made on page 82.

Table 4-22. Missouri basin land use

Land Use Category	Subbasins								Missouri Drainage Total	
	Headwaters		Upper Missouri		Marias/Teton		Middle Missouri			
	Thousand Acres	% of Area	Thousand Acres	% of Area	Thousand Acres	% of Area	Thousand Acres	% of Area	Thousand Acres	% of Area
Cropland total	562	6%	542	9%	2,944	27	1,992	10%	6,031	13%
Dryland^c	*125	~~22%~~	*371	~~*68%~~	*2,477	~~*84%~~	*1,636	~~*82%~~	*4,609	~~*76%~~
Irrigated^d	*384	~~*68%~~	*120	~~*22%~~	*189	~~* 6%~~	*169	~~*8%~~	*853	~~*14%~~
Idle and pasture^e	*53	~~*9%~~	*51	~~*9%~~	*278	~~*10%~~	*187	~~*9%~~	*569	~~*9%~~
Developed residential areas^b	77	0.9%	122	2%	29	0.3%	45	0.2%	273	0.6%
Urban areas	*65		*113		*13		*17		*208	
Farmsteads and farm roads	*13		*9		*16		*28		*65	

The following changes were made on page 83.

Harvested cropland figures throughout this EIS underestimate total irrigated land because they do not take into account unharvested land, subirrigated land, and land receiving occasional water spreading. Furthermore, harvested croplands are average values, whereas total irrigated acres are the maximum ever irrigated. Irrigated cropland information from the Montana ~~Agricultural Statistics~~ Crop and Livestock Reporting Service (1964 through 1989) is presented to show relative trends over time (Figure 4-7).

Irrigated alfalfa acreage in the basin above Fort Peck has averaged about ~~135,000~~ 360,000 harvested acres over the past 20 years. Even though irrigated acreage did not increase significantly, irrigated alfalfa production grew 24 percent over the past 25 years, due primarily to the increased crop yields (Figure 4-8).

The following changes were made on page 121.

Table 4-51. Angler use of reservoirs and lakes in the Marias/Teton Subbasin from 1982 to 1986

Source: ~~DFWP~~ McFarland 1989

Table 4-52. Use of Marias/Teton Subbasin rivers and reservoirs by Montana residents and nonresident anglers

Source: DNRC 1990b

MIDDLE MISSOURI SUBBASIN

Angler use on Middle Missouri Subbasin rivers and streams is substantially lower than in the Headwaters and Upper Missouri subbasins, probably because of the greater distance of these streams from major population centers. Angler use for this subbasin in 1985 totaled ~~33,558~~ 50,600 days, representing ~~2.8~~ 3.8 percent of the state total (Map 4-7). Map 4-11 shows angler use, selected recreation sites, and estimated nonangler use levels on streams in the Middle Missouri Subbasin. Table 4-53 lists angler use on selected reservoirs in this subbasin.

The following changes were made on page 140.

Table 5-1. Reservation requests included under each alternative

Beaverhead River Drainage

APPLICANT/ PROJECT	SOURCE	TYPE OF RESERVATION	AMOUNT (cfs)	ALTERNATIVES			
				CONSUMPTIVE USE	INSTREAM	COMBINATION	NO ACTION
DFWP	Big Sheep Creek	Instream	33.0[a]	░	▓	░	
BLM-Minimum Flows	Big Sheep Creek	Instream	~~40.0~~ 33.0	░	▓	░	
~~BLM-Maximum Flows~~	~~Big Sheep Creek~~	~~Instream~~	~~300.0~~	░	▓	░	
DFWP	Black Canyon Creek	Instream	2.5	░	▓	░	

The following change was made on page 145.

Dearborn River Drainage

APPLICANT/ PROJECT	SOURCE	TYPE OF RESERVATION	AMOUNT (cfs)	ALTERNATIVES			
				CONSUMPTIVE USE	INSTREAM	COMBINATION	NO ACTION
LCI-20	Dearborn River	Irrigation	2.5	▓		▓	
DFWP	Bean Lake	Instream	2,648 af	░	▓	░	
DFWP	Dearborn River	Instream	~~109.0~~ 110.0	░	▓	░	
DFWP	Flat Creek	Instream	7.5	░	▓	░	

The following change was made on page 149.

Teton River Drainage (continued)

APPLICANT/ PROJECT	SOURCE	TYPE OF RESERVATION	AMOUNT (cfs)	ALTERNATIVES			
				CONSUMPTIVE USE	INSTREAM	COMBINATION	NO ACTION
TEI-70	Teton River	Irrigation	4.4	▓			
TE-401	Unnamed tributary of Teton River	Irrigation	2.7	▓			
DFWP	Antelope Butte Swamp	Instream	~~450.0~~ 460.0 af	░	▓	░	
DFWP	Deep Creek	Instream	18.0	░	▓	░	

The following change was made on page 191.

Table 6-14. Soil disturbance due to canal construction

Subbasin/Drainage Project	Alternative Consumptive Use (miles)	Instream (miles)	Combination (miles)
Marias/Teton			
Marias			
BSS-~~7~~ 2	16.9	0	16.9

The following changes were made on page 196.

Table 6-15. Projects requiring electric lines 5 or more miles in length

Project	Electric line length (miles) Consumptive Use Alternative	Instream Alternative	Combination Alternative
Upper Missouri Subbasin			
~~K~~BR-104	8.1	—	—

The conservation districts have indicated that alfalfa is the crop most likely to be irrigated with reserved water. This is because alfalfa is considered a highly profitable crop for repaying irrigation investments. Alfalfa yields from irrigated land (described in Chapter Four - Land Use) are expected to continue increasing, going from the present average 3.0 tons per acre to 3.9 tons per acre by the year 2020 (Figure 6-21), resulting in a 31 percent increase in alfalfa production ~~paer~~ per acre. Virtually all alfalfa is used for livestock feed. Montana cattle numbers are projected to remain stable (or decline slightly), while beef production efficiency is expected to increase (USDA 1989), reducing the demand for alfalfa. Existing alfalfa acreage with high production costs may go out of production if less expensive production occurs elsewhere as a result of water reservations.

Table 6-42 in the draft EIS has been replaced by Table 2-4 in this final EIS.

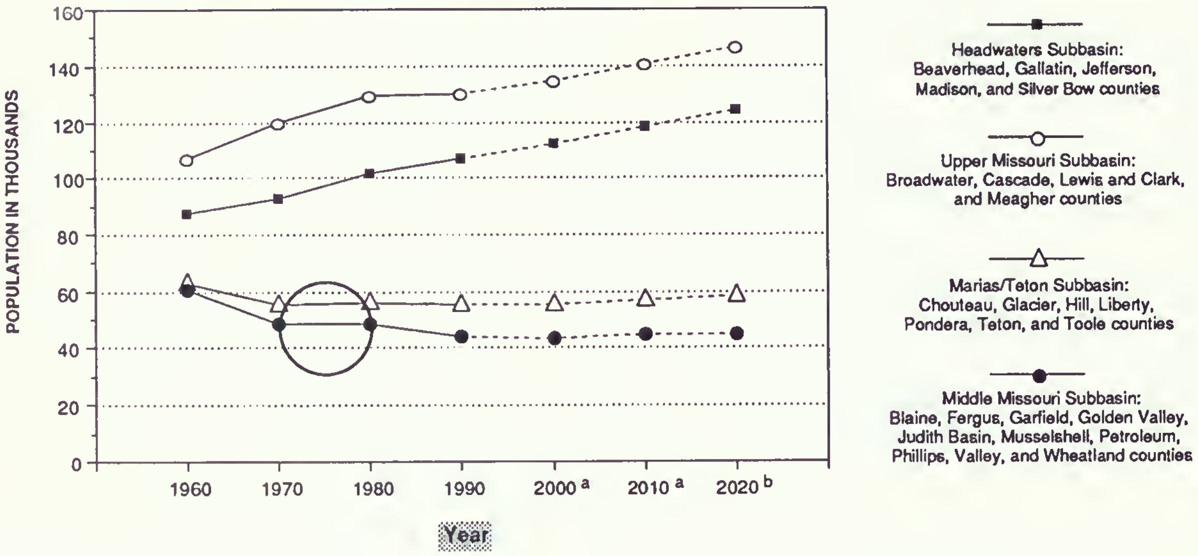
The following changes were made on page 234.

Table 6-46. Economic benefits to agriculture— Upper Missouri Subbasin

Category	1987 Actual[a]	~~Percent~~ Increase[a]	Percent Increase[b]
Instream Alternative			
Jobs	73,327	7	<0.1%
Total Personal Income	$1,761,056,000	$ 349,000	<0.1%
Agriculture Sales	$ 112,298,000	$1,180,000	1.1%
Taxable Valuation	$ 175,828,000	$ 41,000	~~<0.0~~ <0.1%
Tax Receipts	$ 44,706,027	$ 10,000	~~<0.0~~ <0.1%

The following changes were made on page 235.

Figure 6-22. Missouri River basin population trends and projections



[a] Projected populations based on NPA Data, Inc.
[b] Projected populations based on NPA Data, Inc., as extended by DNRC

Table 6-47. Economic benefits to agriculture—Marias/Teton Subbasin

Category	1987 Actual[a]	Increase[a]	Percent Increase[b]
Consumptive Use Alternative			
Jobs	27,173	46	0.2%
Total Personal Income	$708,257,000	$ 1,026,000	0.1%
Agriculture Sales	$276,079,000	$12,818,000	4.6%
Taxable Valuation	$175,357,000	$ 105,000	~~0.0~~ <0.1%
Tax Receipts	$ 39,746,000	$ 25,000	0.1%
Instream Alternative			
Jobs	27,173	3	<0.0%
Total Personal Income	$708,257,000	$ 340,000	<0.0%
Agriculture Sales	$276,079,000	$ 998,000	0.4%
Taxable Valuation	$175,357,000	$ 12,000	~~<0.0~~ <0.1%
Tax Receipts	$ 39,746,000	$ 3,000	~~<0.0~~ <0.1%
Combination Alternative			
Jobs	27,176	17	<0.1%
Total Personal Income	$708,257,000	$ 914,000	0.1%
Agriculture Sales	$276,079,000	$ 4,762,000	1.7%
Taxable Valuation	$175,357,000	$ 44,000	~~<0.0~~ <0.1%
Tax Receipts	$ 39,746,000	$ 10,000	~~<0.0~~ <0.1%

a Dollars are reported to the nearest $1,000 and jobs are rounded to the nearest whole job.
b < 0.1% indicates the increase is less than one-tenth of one percent.

Source: Economic Consultants Northwest 1991b.

The following change was made on page 236.

Table 6-49. Summary of population projections for municipalities requesting reservations

Source: U.S. Bureau of Census ~~1990~~ 1991

The following change was made on page 253.

REDUCED HYDROPOWER PRODUCTION

Streamflow would be reduced under all three alternatives. Lower flows would reduce power production at dams in the Missouri River basin. Annual losses of hydropower production under each alternative are shown in Table 6-43. Table 7-1 shows what it would cost today to replace 70 years of lost generation under the three alternatives. These values range from $213.4 million under the Consumptive Use Alternative to $27.6 million under the Instream Alternative. As explained on page ~~144~~ 232, the cost of replacement power is likely to rise over time. The values in Table 7-1 are therefore conservative.

Table 7-1 of the draft EIS has been replaced by Table 2-3 in this final EIS.

The following change was made on page C-3.

MISSOURI RIVER WATER AVAILABILITY MODEL

DNRC developed a computer model to analyze physical and legal water availability in the Missouri basin and to assess the impacts that the proposed reservation requests could have on streamflows, reservoir levels, and hydropower production ~~(DNRC 1990e)~~. The model has three major components: (1) the streamflow component, (2) the irrigation component, and (3) the dam and reservoir operations component. A diagram of the model is presented in Figure C-1.

The following changes were made to Appendix D to correct stream names and to eliminate streams where DFWP has not requested reservations.

Table D-1. Estimated flows (cfs) for the 50-year period from 1937 to 1986 where reservations are requested by DFWP

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
GALLATIN RIVER DRAINAGE													
~~Bear Canyon Creek near Bozeman~~													
~~90 %~~	~~2~~	~~1~~	~~0.7~~	~~0.6~~	~~0.5~~	~~1~~	~~5~~	~~16~~	~~10~~	~~2~~	~~0.8~~	~~1~~	~~3.4~~
~~80 %~~	~~2~~	~~2~~	~~1~~	~~1~~	~~1~~	~~2~~	~~6~~	~~20~~	~~13~~	~~4~~	~~2~~	~~2~~	~~5~~
~~50 %~~	~~3~~	~~2~~	~~2~~	~~1~~	~~2~~	~~3~~	~~11~~	~~30~~	~~23~~	~~7~~	~~3~~	~~3~~	~~8~~
~~20 %~~	~~4~~	~~4~~	~~3~~	~~2~~	~~3~~	~~5~~	~~20~~	~~43~~	~~37~~	~~13~~	~~5~~	~~4~~	~~12~~
~~AVG~~	~~3~~	~~3~~	~~2~~	~~2~~	~~2~~	~~4~~	~~13~~	~~32~~	~~26~~	~~8~~	~~4~~	~~3~~	~~8~~
MADISON RIVER DRAINAGE													
~~Soap Creek at mouth near Cameron~~													
~~90 %~~	~~0.6~~	~~0.5~~	~~0.6~~	~~0.4~~	~~0.5~~	~~0.5~~	~~2~~	~~8~~	~~6~~	~~2~~	~~1~~	~~1~~	~~2~~
~~80 %~~	~~0.8~~	~~0.7~~	~~0.6~~	~~0.5~~	~~0.5~~	~~0.6~~	~~2~~	~~10~~	~~7~~	~~2~~	~~2~~	~~1~~	~~2~~
~~50 %~~	~~1~~	~~1~~	~~0.8~~	~~0.8~~	~~0.7~~	~~1~~	~~3~~	~~14~~	~~12~~	~~4~~	~~2~~	~~1~~	~~3~~
~~20 %~~	~~2~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~5~~	~~18~~	~~18~~	~~6~~	~~3~~	~~2~~	~~5~~
~~AVG~~	~~2~~	~~1~~	~~1~~	~~0.8~~	~~0.8~~	~~1~~	~~4~~	~~14~~	~~13~~	~~4~~	~~2~~	~~2~~	~~4~~

Table D-1 (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
JEFFERSON RIVER DRAINAGE													
~~Norwegian Creek near Harrison~~													
~~90 %~~	~~5~~	~~5~~	~~5~~	~~3~~	~~4~~	~~5~~	~~8~~	~~7~~	~~6~~	~~3~~	~~3~~	~~5~~	~~5~~
~~80 %~~	~~6~~	~~6~~	~~5~~	~~3~~	~~4~~	~~6~~	~~8~~	~~9~~	~~7~~	~~4~~	~~4~~	~~5~~	~~6~~
~~50 %~~	~~7~~	~~6~~	~~5~~	~~4~~	~~5~~	~~7~~	~~10~~	~~12~~	~~10~~	~~6~~	~~7~~	~~7~~	~~7~~
~~20 %~~	~~8~~	~~7~~	~~6~~	~~5~~	~~5~~	~~7~~	~~12~~	~~14~~	~~13~~	~~10~~	~~9~~	~~10~~	~~9~~
~~AVG~~	~~7~~	~~6~~	~~5~~	~~4~~	~~5~~	~~7~~	~~10~~	~~12~~	~~10~~	~~7~~	~~8~~	~~7~~	~~7~~
BIG HOLE RIVER DRAINAGE													
~~Adson Creek at mouth near Wise River~~													
~~90 %~~	~~1~~	~~1~~	~~1~~	~~0.7~~	~~0.8~~	~~0.9~~	~~2~~	~~11~~	~~8~~	~~3~~	~~2~~	~~1~~	~~2.7~~
~~80 %~~	~~1~~	~~1~~	~~1~~	~~0.9~~	~~1~~	~~1~~	~~3~~	~~14~~	~~10~~	~~4~~	~~2~~	~~2~~	~~3.4~~
~~50 %~~	~~2~~	~~2~~	~~1~~	~~1~~	~~1~~	~~2~~	~~5~~	~~20~~	~~18~~	~~6~~	~~3~~	~~2~~	~~5~~
~~20 %~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~2~~	~~8~~	~~27~~	~~27~~	~~9~~	~~4~~	~~3~~	~~8~~
~~AVG~~	~~2~~	~~2~~	~~2~~	~~1~~	~~1~~	~~2~~	~~6~~	~~21~~	~~20~~	~~6~~	~~3~~	~~3~~	~~6~~
~~Andrus Creek near mouth near Jackson~~													
~~90 %~~	~~3~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~5~~	~~20~~	~~16~~	~~6~~	~~4~~	~~3~~	~~6~~
~~80 %~~	~~4~~	~~3~~	~~3~~	~~2~~	~~2~~	~~3~~	~~7~~	~~25~~	~~21~~	~~8~~	~~4~~	~~4~~	~~7~~
~~50 %~~	~~5~~	~~4~~	~~3~~	~~3~~	~~3~~	~~4~~	~~12~~	~~38~~	~~37~~	~~12~~	~~7~~	~~5~~	~~11~~
~~20 %~~	~~7~~	~~6~~	~~4~~	~~4~~	~~4~~	~~6~~	~~18~~	~~53~~	~~55~~	~~19~~	~~10~~	~~7~~	~~16~~
~~AVG~~	~~6~~	~~5~~	~~4~~	~~3~~	~~3~~	~~4~~	~~13~~	~~40~~	~~40~~	~~14~~	~~7~~	~~6~~	~~12~~
~~Fox Creek at mouth near Jackson~~													
~~90 %~~	~~2~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~3~~	~~15~~	~~11~~	~~4~~	~~3~~	~~2~~	~~4~~
~~80 %~~	~~2~~	~~2~~	~~2~~	~~1~~	~~1~~	~~2~~	~~5~~	~~18~~	~~14~~	~~5~~	~~3~~	~~2~~	~~5~~
~~50 %~~	~~3~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~8~~	~~26~~	~~25~~	~~8~~	~~5~~	~~3~~	~~7~~
~~20 %~~	~~5~~	~~4~~	~~3~~	~~3~~	~~3~~	~~3~~	~~11~~	~~36~~	~~37~~	~~12~~	~~6~~	~~5~~	~~11~~
~~AVG~~	~~4~~	~~3~~	~~2~~	~~2~~	~~2~~	~~3~~	~~8~~	~~28~~	~~27~~	~~9~~	~~5~~	~~4~~	~~8~~
~~Gold Creek at mouth near Wise River~~													
~~90 %~~	~~1~~	~~1~~	~~1~~	~~0.9~~	~~1~~	~~1~~	~~3~~	~~15~~	~~11~~	~~4~~	~~2~~	~~2~~	~~4~~
~~80 %~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~4~~	~~18~~	~~13~~	~~5~~	~~3~~	~~2~~	~~4~~
~~50 %~~	~~2~~	~~2~~	~~2~~	~~2~~	~~1~~	~~2~~	~~6~~	~~25~~	~~23~~	~~7~~	~~4~~	~~3~~	~~7~~
~~20 %~~	~~4~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~9~~	~~32~~	~~33~~	~~11~~	~~5~~	~~4~~	~~9~~
~~AVG~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~2~~	~~7~~	~~26~~	~~25~~	~~8~~	~~4~~	~~3~~	~~7~~
~~Lacy Creek at mouth near Wise River~~													
~~90 %~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~2~~	~~6~~	~~28~~	~~21~~	~~7~~	~~4~~	~~3~~	~~7~~
~~80 %~~	~~4~~	~~3~~	~~3~~	~~2~~	~~2~~	~~3~~	~~7~~	~~33~~	~~26~~	~~9~~	~~5~~	~~4~~	~~8~~
~~50 %~~	~~5~~	~~4~~	~~4~~	~~3~~	~~3~~	~~4~~	~~12~~	~~47~~	~~45~~	~~14~~	~~8~~	~~5~~	~~13~~
~~20 %~~	~~7~~	~~6~~	~~5~~	~~4~~	~~4~~	~~5~~	~~18~~	~~62~~	~~65~~	~~22~~	~~10~~	~~7~~	~~18~~
~~AVG~~	~~6~~	~~5~~	~~4~~	~~3~~	~~3~~	~~4~~	~~13~~	~~49~~	~~49~~	~~16~~	~~8~~	~~6~~	~~14~~
~~Meadow Creek near Wise River~~													
~~90 %~~	~~2~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~4~~	~~15~~	~~11~~	~~4~~	~~3~~	~~2~~	~~4~~
~~80 %~~	~~2~~	~~2~~	~~2~~	~~1~~	~~2~~	~~2~~	~~5~~	~~19~~	~~15~~	~~5~~	~~3~~	~~3~~	~~5~~
~~50 %~~	~~3~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~8~~	~~27~~	~~26~~	~~8~~	~~5~~	~~3~~	~~8~~
~~20 %~~	~~5~~	~~4~~	~~3~~	~~3~~	~~3~~	~~3~~	~~12~~	~~37~~	~~38~~	~~13~~	~~7~~	~~5~~	~~11~~
~~AVG~~	~~4~~	~~3~~	~~2~~	~~2~~	~~2~~	~~3~~	~~8~~	~~29~~	~~28~~	~~9~~	~~5~~	~~4~~	~~8~~
~~Mono Creek at mouth near Wise River~~													
~~90 %~~	~~0.9~~	~~0.8~~	~~0.8~~	~~0.6~~	~~0.7~~	~~0.7~~	~~2~~	~~10~~	~~7~~	~~3~~	~~2~~	~~1~~	~~2.5~~
~~80 %~~	~~1~~	~~1~~	~~0.9~~	~~0.7~~	~~0.8~~	~~1~~	~~3~~	~~12~~	~~9~~	~~3~~	~~2~~	~~1~~	~~3.0~~
~~50 %~~	~~2~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~5~~	~~17~~	~~16~~	~~5~~	~~3~~	~~2~~	~~5~~
~~20 %~~	~~3~~	~~2~~	~~2~~	~~1~~	~~2~~	~~2~~	~~7~~	~~23~~	~~23~~	~~7~~	~~4~~	~~3~~	~~7~~
~~AVG~~	~~2~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~5~~	~~18~~	~~17~~	~~6~~	~~3~~	~~2~~	~~5~~
Sevenmile Creek at mouth near Wise River													
90 %	0.4	0.3	0.3	0.3	0.3	0.3	1	5	3	1	0.8	0.6	1.1
80 %	0.6	0.5	0.4	0.3	0.4	0.4	1	6	4	2	1	0.7	1.4
50 %	0.9	0.7	0.5	0.5	0.5	0.6	2	8	8	2	2	1	2.2
20 %	1	1	0.7	0.7	0.7	1	4	11	11	4	2	1	3.2
AVG	1	0.8	0.6	0.5	0.5	0.7	3	9	8	3	2	1	2.5
~~Sheep Creek at mouth near Wise River~~													
~~90 %~~	~~2~~	~~1~~	~~2~~	~~1~~	~~1~~	~~1~~	~~4~~	~~19~~	~~13~~	~~5~~	~~3~~	~~2~~	~~4~~
~~80 %~~	~~2~~	~~2~~	~~2~~	~~1~~	~~1~~	~~2~~	~~5~~	~~22~~	~~17~~	~~6~~	~~3~~	~~3~~	~~6~~
~~50 %~~	~~3~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~8~~	~~31~~	~~29~~	~~9~~	~~5~~	~~3~~	~~8~~
~~20 %~~	~~5~~	~~4~~	~~3~~	~~3~~	~~3~~	~~3~~	~~12~~	~~41~~	~~42~~	~~14~~	~~7~~	~~5~~	~~12~~
~~AVG~~	~~4~~	~~3~~	~~2~~	~~2~~	~~2~~	~~3~~	~~8~~	~~32~~	~~32~~	~~10~~	~~5~~	~~4~~	~~9~~
~~Tie Creek at Forest Service boundary near Wisdom~~													
~~90 %~~	~~5~~	~~5~~	~~5~~	~~4~~	~~4~~	~~5~~	~~10~~	~~51~~	~~40~~	~~13~~	~~8~~	~~6~~	~~13~~
~~80 %~~	~~7~~	~~6~~	~~5~~	~~5~~	~~5~~	~~5~~	~~13~~	~~61~~	~~51~~	~~17~~	~~9~~	~~7~~	~~16~~
~~50 %~~	~~9~~	~~8~~	~~7~~	~~6~~	~~6~~	~~7~~	~~21~~	~~86~~	~~85~~	~~27~~	~~14~~	~~10~~	~~24~~
~~20 %~~	~~14~~	~~11~~	~~9~~	~~8~~	~~8~~	~~10~~	~~33~~	~~110~~	~~120~~	~~42~~	~~18~~	~~13~~	~~33~~
~~AVG~~	~~10~~	~~9~~	~~8~~	~~6~~	~~6~~	~~8~~	~~24~~	~~89~~	~~93~~	~~30~~	~~14~~	~~11~~	~~26~~

Table D-1 (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
RUBY RIVER DRAINAGE													
~~Ruby River above the forks near Alder~~													
~~90 %~~	~~6~~	~~6~~	~~5~~	~~4~~	~~5~~	~~5~~	~~11~~	~~40~~	~~33~~	~~12~~	~~7~~	~~6~~	~~12~~
~~80 %~~	~~8~~	~~7~~	~~6~~	~~5~~	~~6~~	~~6~~	~~14~~	~~50~~	~~44~~	~~16~~	~~9~~	~~8~~	~~15~~
~~50 %~~	~~11~~	~~9~~	~~7~~	~~7~~	~~7~~	~~8~~	~~23~~	~~75~~	~~77~~	~~26~~	~~14~~	~~10~~	~~23~~
~~20 %~~	~~14~~	~~12~~	~~9~~	~~8~~	~~9~~	~~12~~	~~35~~	~~100~~	~~110~~	~~40~~	~~19~~	~~15~~	~~32~~
~~AVG~~	~~11~~	~~10~~	~~8~~	~~7~~	~~7~~	~~9~~	~~25~~	~~79~~	~~83~~	~~29~~	~~14~~	~~12~~	~~24~~
RED ROCK RIVER AND BEAVERHEAD RIVER DRAINAGES													
~~Antelope Creek near Lakeview~~													
~~90 %~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.2~~	~~0.3~~	~~2~~	~~1~~	~~0.3~~	~~0.2~~	~~0.2~~	~~0.4~~
~~80 %~~	~~0.2~~	~~0.2~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.2~~	~~0.3~~	~~2~~	~~1~~	~~0.3~~	~~0.2~~	~~0.2~~	~~0.4~~
~~50 %~~	~~0.2~~	~~0.2~~	~~0.2~~	~~0.2~~	~~0.2~~	~~0.2~~	~~0.5~~	~~2~~	~~3~~	~~0.6~~	~~0.3~~	~~0.2~~	~~0.6~~
~~20 %~~	~~0.4~~	~~0.3~~	~~0.3~~	~~0.2~~	~~0.2~~	~~0.2~~	~~1~~	~~3~~	~~4~~	~~1~~	~~0.4~~	~~0.3~~	~~0.9~~
~~AVG~~	~~0.3~~	~~0.3~~	~~0.2~~	~~0.2~~	~~0.2~~	~~0.2~~	~~0.7~~	~~2~~	~~3~~	~~0.7~~	~~0.3~~	~~0.2~~	~~0.7~~
East Fork Blacktail Deer Creek near Dillon													
90 %	15	16	12	11	11	12	19	48	42	25	16	14	20
80 %	17	16	13	13	11	13	26	64	63	30	18	16	25
50 %	21	19	16	13	13	14	37	110	97	40	23	20	35
20 %	22	19	16	15	19	20	50	140	140	47	29	24	45
AVG	19	17	15	13	15	15	38	110	100	40	24	20	36
~~Painter Creek near Grant~~													
~~90 %~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~3~~	~~16~~	~~12~~	~~4~~	~~3~~	~~2~~	~~4~~
~~80 %~~	~~2~~	~~2~~	~~2~~	~~1~~	~~1~~	~~2~~	~~5~~	~~20~~	~~15~~	~~5~~	~~3~~	~~2~~	~~5~~
~~50 %~~	~~3~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~7~~	~~28~~	~~26~~	~~8~~	~~5~~	~~3~~	~~8~~
~~20 %~~	~~4~~	~~3~~	~~3~~	~~2~~	~~2~~	~~3~~	~~11~~	~~37~~	~~38~~	~~13~~	~~6~~	~~4~~	~~10~~
~~AVG~~	~~3~~	~~3~~	~~2~~	~~2~~	~~2~~	~~2~~	~~8~~	~~29~~	~~29~~	~~9~~	~~5~~	~~4~~	~~8~~
~~Pole Creek near mouth near Polaris~~													
~~90 %~~	~~0.6~~	~~0.5~~	~~0.5~~	~~0.4~~	~~0.4~~	~~0.5~~	~~1~~	~~7~~	~~5~~	~~2~~	~~1~~	~~0.8~~	~~1.6~~
~~80 %~~	~~0.8~~	~~0.7~~	~~0.6~~	~~0.5~~	~~0.5~~	~~0.6~~	~~2~~	~~9~~	~~6~~	~~2~~	~~1~~	~~1~~	~~2.1~~
~~50 %~~	~~1~~	~~1~~	~~0.8~~	~~0.7~~	~~0.7~~	~~0.9~~	~~3~~	~~12~~	~~11~~	~~3~~	~~2~~	~~1~~	~~3.1~~
~~20 %~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~5~~	~~16~~	~~16~~	~~5~~	~~3~~	~~2~~	~~4~~
~~AVG~~	~~1~~	~~1~~	~~0.9~~	~~0.7~~	~~0.8~~	~~1~~	~~4~~	~~13~~	~~12~~	~~4~~	~~2~~	~~2~~	~~3.5~~
West Fork Blacktail Deer Creek near Dillon													
90 %	5	7	5	4	4	5	9	17	13	6	5	4	7
80 %	7	7	6	5	5	6	11	23	17	8	7	6	9
50 %	10	9	7	6	6	8	15	28	32	13	11	8	13
20 %	12	11	8	7	8	10	20	42	51	19	16	11	18
AVG	9	9	7	6	6	9	16	30	35	14	11	8	13
MISSOURI RIVER DRAINAGE - THREE FORKS TO HOLTER DAM													
~~Elkhorn Creek near mouth near Wolf Creek~~													
~~90 %~~	~~3~~	~~3~~	~~3~~	~~2~~	~~3~~	~~3~~	~~5~~	~~13~~	~~12~~	~~4~~	~~2~~	~~2~~	~~5~~
~~80 %~~	~~3~~	~~3~~	~~3~~	~~3~~	~~3~~	~~4~~	~~5~~	~~16~~	~~14~~	~~5~~	~~3~~	~~3~~	~~5~~
~~50 %~~	~~4~~	~~4~~	~~4~~	~~3~~	~~4~~	~~4~~	~~8~~	~~20~~	~~24~~	~~9~~	~~5~~	~~4~~	~~8~~
~~20 %~~	~~6~~	~~6~~	~~5~~	~~5~~	~~4~~	~~5~~	~~11~~	~~27~~	~~36~~	~~14~~	~~7~~	~~5~~	~~11~~
~~AVG~~	~~5~~	~~5~~	~~4~~	~~4~~	~~4~~	~~5~~	~~8~~	~~21~~	~~26~~	~~10~~	~~5~~	~~4~~	~~8~~
SMITH RIVER DRAINAGE													
~~Camas Creek near mouth near White Sulphur Springs~~													
~~90 %~~	~~3~~	~~3~~	~~3~~	~~3~~	~~3~~	~~4~~	~~7~~	~~38~~	~~27~~	~~7~~	~~4~~	~~3~~	~~9~~
~~80 %~~	~~4~~	~~5~~	~~4~~	~~3~~	~~4~~	~~5~~	~~10~~	~~47~~	~~32~~	~~8~~	~~5~~	~~4~~	~~11~~
~~50 %~~	~~5~~	~~6~~	~~5~~	~~5~~	~~5~~	~~7~~	~~16~~	~~52~~	~~58~~	~~15~~	~~8~~	~~6~~	~~16~~
~~20 %~~	~~9~~	~~9~~	~~7~~	~~6~~	~~6~~	~~10~~	~~29~~	~~76~~	~~96~~	~~32~~	~~11~~	~~9~~	~~25~~
~~AVG~~	~~7~~	~~7~~	~~6~~	~~5~~	~~5~~	~~8~~	~~20~~	~~54~~	~~65~~	~~19~~	~~8~~	~~7~~	~~18~~
SUN RIVER DRAINAGE													
~~North Fork Sun River near Augusta~~													
~~90 %~~	~~65~~	~~67~~	~~59~~	~~58~~	~~47~~	~~48~~	~~67~~	~~810~~	~~720~~	~~260~~	~~100~~	~~90~~	~~199~~
~~80 %~~	~~71~~	~~69~~	~~63~~	~~54~~	~~52~~	~~53~~	~~88~~	~~960~~	~~830~~	~~310~~	~~130~~	~~95~~	~~231~~
~~50 %~~	~~94~~	~~86~~	~~71~~	~~65~~	~~64~~	~~61~~	~~160~~	~~1200~~	~~1300~~	~~460~~	~~160~~	~~110~~	~~319~~
~~20 %~~	~~140~~	~~110~~	~~94~~	~~74~~	~~74~~	~~80~~	~~300~~	~~1500~~	~~2000~~	~~700~~	~~210~~	~~140~~	~~452~~
~~AVG~~	~~110~~	~~92~~	~~79~~	~~66~~	~~65~~	~~68~~	~~200~~	~~1300~~	~~1400~~	~~500~~	~~160~~	~~120~~	~~347~~
~~Smith Creek near Augusta~~													
~~90 %~~	~~6~~	~~4~~	~~5~~	~~4~~	~~4~~	~~8~~	~~6~~	~~42~~	~~34~~	~~25~~	~~6~~	~~4~~	~~12~~
~~80 %~~	~~7~~	~~6~~	~~6~~	~~5~~	~~5~~	~~10~~	~~7~~	~~52~~	~~43~~	~~30~~	~~8~~	~~6~~	~~15~~
~~50 %~~	~~14~~	~~12~~	~~8~~	~~7~~	~~8~~	~~13~~	~~17~~	~~70~~	~~69~~	~~47~~	~~12~~	~~9~~	~~24~~
~~20 %~~	~~21~~	~~16~~	~~12~~	~~10~~	~~16~~	~~17~~	~~34~~	~~100~~	~~110~~	~~59~~	~~17~~	~~16~~	~~36~~
~~AVG~~	~~15~~	~~12~~	~~10~~	~~7~~	~~10~~	~~17~~	~~25~~	~~75~~	~~86~~	~~48~~	~~13~~	~~11~~	~~27~~

Table D-1 (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
MARIAS RIVER DRAINAGE													
North ~~Fork~~ Badger Creek near Browning													
90 %	9	8	9	7	7	8	18	140	100	28	17	13	30
80 %	11	10	10	8	8	9	24	150	130	39	19	14	36
50 %	16	15	13	11	11	12	38	200	190	59	26	17	51
20 %	25	21	18	15	14	15	59	240	270	91	33	22	69
AVG	19	16	15	12	11	12	42	200	210	65	26	18	54
South ~~Fork~~ Badger Creek near Browning													
90 %	9	9	10	8	8	9	19	150	120	31	19	14	34
80 %	13	11	11	9	9	10	26	170	140	43	21	15	40
50 %	18	16	14	12	12	13	41	210	210	65	28	18	55
20 %	28	23	19	16	15	16	64	270	300	100	36	23	76
AVG	20	17	16	13	12	14	45	220	230	71	28	20	59
JUDITH RIVER DRAINAGE													
Lost ~~Creek~~ Fork Judith River at mouth near Utica													
90 %	5	5	5	4	4	5	10	46	36	12	7	6	12
80 %	7	6	5	5	5	6	13	55	47	16	9	7	15
50 %	9	8	7	6	6	7	21	79	79	26	13	10	23
20 %	13	11	9	8	8	10	33	110	120	40	18	13	33
AVG	10	9	7	6	6	8	23	83	86	29	14	11	24

The following changes were made on pages K-4 through K-6.

Table K-3. Reservation requests for instream flows on streams with no competing requests

APPLICANT	STREAM	FISHERIES VALUE CLASS[c]
HEADWATERS SUBBASIN		
GALLATIN RIVER DRAINAGE		
DFWP	East Gallatin River #1	2
MADISON RIVER DRAINAGE		
DFWP	Madison River #2	1
DFWP	Madison River #3	1
BEAVERHEAD RIVER DRAINAGE		
~~BLM~~	~~Trapper Creek~~	~~[a]~~
UPPER MISSOURI SUBBASIN		
MISSOURI RIVER DRAINAGE - THREE FORKS TO HOLTER DAM		
DFWP	Canyon Creek	4
DFWP	Little Prickly Pear Creek #1	2
DFWP	Little Prickly Pear Creek #2	2
DFWP	Lyons Creek	2
~~DFWP~~	~~Prickly Pear Creek~~	~~2~~[b]
DFWP	Spokane Creek	3
~~DFWP~~	~~Tenmile Creek~~	~~4[a]~~
DFWP	Virginia Creek	4
DFWP	Wolf Creek	3
SUN RIVER DRAINAGE		
~~DFWP~~	~~Elk Creek~~	~~3~~
MIDDLE MISSOURI SUBBASIN		
MISSOURI RIVER DRAINAGE - BELT CREEK TO FORT PECK DAM		
DFWP	Highwood Creek (upper)	3[b]
DFWP	Shonkin Creek (upper)	3

Table K-4 in Appendix K in the draft EIS has been replaced with Table B-1 in this final EIS.

The following changes were made on pages K-12 and K-13.

Table K-5. Value of instream flows on streams with competing consumptive use requests

Drainage	Stream	Applicant	Instream Value $ per acre-foot	Fisheries Value Class^{ab}
HEADWATERS SUBBASIN				
Gallatin River	~~East Gallatin River #1~~	~~DFWP~~	~~77.92~~	~~2~~
	~~Gallatin River #1~~	~~DFWP~~	~~77.92~~	~~2~~
Madison River	~~Madison River #2~~	~~DFWP~~	~~77.92~~	~~1~~
	~~Madison River #3~~	~~DFWP~~	~~77.92~~	~~1~~
UPPER MISSOURI SUBBASIN				
Missouri River—Three Forks to Holter Dam	Prickly Pear Creek #2	DFWP	66.29	2,3,4
	~~Warm Springs Creek~~	~~DFWP~~	~~72.37~~	~~6~~
MARIAS/TETON SUBBASIN				
Marias River	Birch Creek	DFWP	32.71	4
MIDDLE MISSOURI SUBBASIN				
Missouri River—Belt Creek to Fort Peck Reservoir	~~Highwood Creek~~	~~DFWP~~	~~32.71~~	~~3,4~~
	~~Shonkin Creek~~	~~DFWP~~	~~32.71~~	~~3~~
Judith River	East Fork Big Spring Creek	DFWP	32.71	6
	Warm Spring Creek	DFWP	32.71	3

The following changes were made on page K-13.

Table K-7. Municipal water system characteristics

Municipal Requests	Water Distribution Systems with Substantial Leakage	Percent of Service Metered	Unmetered Service
Belgrade	~~Yes~~	~~18%~~ 80%	

APPENDIX A

MODEL RESULTS AND SENSITIVITY ANALYSIS

Table A-1. Monthly streamflow percentile distributions (cfs)

BASELINE CONDITIONS

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
BIG HOLE RIVER NEAR MELROSE	1	Average	518	505	395	349	365	462	1537	3499	4228	1435	450	367	1176
		10	797	684	526	456	482	706	2428	5534	6588	2448	774	593	1835
		20	673	617	457	420	415	530	2068	4549	5903	2024	668	514	1570
		50	469	474	355	347	341	399	1300	3156	4072	1409	450	324	1092
		80	333	360	287	254	289	337	890	2002	2497	666	204	207	694
		90	269	318	269	215	249	312	666	1870	1272	368	47	135	499
BEAVERHEAD RIVER ABOVE DILLON	2	Average	261	285	250	206	207	227	273	398	581	456	424	305	323
		10	456	473	385	308	298	349	487	719	980	768	775	508	542
		20	380	393	332	250	268	308	393	650	841	716	651	424	467
		50	217	280	245	206	209	215	214	345	537	497	390	243	300
		80	109	130	139	112	115	125	140	134	211	168	120	128	136
		90	87	96	94	84	99	102	96	86	123	15	17	70	81
BEAVERHEAD RIVER NEAR TWIN BRIDGES	3	Average	421	571	511	422	444	495	494	306	447	392	312	401	435
		10	728	792	678	560	560	626	820	611	915	726	548	640	684
		20	590	676	602	498	507	562	641	505	676	642	475	568	579
		50	410	559	496	416	437	494	447	206	348	386	308	386	408
		80	156	423	395	325	363	377	311	100	72	41	61	128	229
		90	106	347	338	263	325	348	263	51	0	0	0	91	178
MOUTH OF RUBY RIVER	4	Average	238	231	179	144	135	165	198	227	304	120	68	224	186
		10	301	295	238	180	168	226	331	405	609	330	195	305	299
		20	289	275	209	166	148	209	283	352	530	223	134	283	258
		50	242	232	167	138	130	149	176	208	236	89	40	221	169
		80	180	186	153	121	115	116	102	89	50	0	0	168	107
		90	152	165	147	118	109	109	92	40	0	0	0	154	90
JEFFERSON RIVER NEAR TWIN BRIDGES	5	Average	1283	1468	1242	1062	1101	1229	2325	3863	5201	1901	730	990	1866
		10	1869	1875	1518	1306	1328	1634	3333	6269	8071	3436	1336	1468	2787
		20	1622	1724	1395	1205	1235	1422	3034	5137	7176	2775	1079	1277	2423
		50	1270	1420	1210	1053	1071	1164	2030	3466	5108	1809	739	931	1773
		80	871	1203	1044	904	930	1010	1506	2311	2862	723	201	657	1185
		90	723	1086	977	804	845	921	1326	2020	1631	274	0	461	922
JEFFERSON RIVER NEAR THREE FORKS	6	Average	1789	1895	1459	1319	1347	1649	2567	4332	6396	1914	796	1283	2229
		10	2597	2381	1933	1621	1846	2025	3498	6911	10700	3591	1694	1921	3393
		20	2231	2173	1714	1516	1565	1886	3135	6017	9447	2678	1160	1643	2930
		50	1806	1893	1456	1334	1339	1638	2610	3970	6180	1748	727	1191	2158
		80	1146	1519	1137	1087	1034	1395	1688	2242	2913	523	172	866	1310
		90	966	1369	990	980	831	1317	1447	1811	2125	247	0	597	1057
GALLATIN RIVER NEAR LOGAN	7	Average	748	813	746	680	709	820	1072	2082	3052	1394	692	637	1120
		10	1117	1096	927	861	854	1001	1427	3171	4733	2099	993	976	1605
		20	991	991	864	799	809	926	1291	2687	4262	1877	888	851	1436
		50	812	814	763	689	719	810	996	2092	3066	1306	638	630	1111
		80	489	659	610	567	578	706	798	1233	1672	871	485	453	760
		90	340	458	507	480	496	619	703	1043	1305	652	387	220	601
MADISION RIVER INFLOWS TO HEBGEN RESERVOIR	8	Average	863	880	799	776	758	754	930	1666	1926	993	804	826	998
		10	1060	1094	1012	917	899	945	1223	2278	3118	1467	1079	1115	1351
		20	949	956	925	894	846	862	1052	2021	2533	1325	1007	960	1194
		50	808	786	791	758	772	754	881	1594	1814	938	758	762	952
		80	696	655	646	665	663	629	756	1241	1189	700	626	640	759
		90	634	609	585	611	600	583	716	1133	1002	616	579	590	588

Baseline conditions (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
HEBGEN RESERVOIR OUTFLOWS TO MADISON RIVER	9	Average	1462	1405	872	783	705	815	991	1053	1193	973	883	1102	1020
		10	1955	1815	1106	923	837	1046	1373	1594	1684	1366	1273	1511	1374
		20	1688	1596	990	898	781	923	1138	1265	1389	1233	1226	1438	1214
		50	1308	1290	853	762	712	796	963	1037	1100	1023	851	998	974
		80	1204	1098	700	672	611	684	811	715	968	642	536	780	785
		90	1175	1044	638	611	564	565	710	703	913	413	472	735	712
MADISON RIVER BELOW ENNIS LAKE	10	Average	2016	2079	1412	1280	1240	1429	1561	2130	2798	1773	1382	1579	1723
		10	2778	2708	1713	1565	1486	1715	2075	2972	3842	2382	1772	2054	2255
		20	2374	2476	1631	1502	1438	1548	1781	2571	3638	1980	1763	2023	2060
		50	1877	1949	1381	1247	1270	1456	1600	1872	2606	1844	1408	1437	1662
		80	1712	1706	1208	1064	1063	1265	1328	1723	2098	1329	959	1261	1393
		90	1646	1557	1127	999	1020	1131	1107	1388	1659	932	791	1183	1212
MADISION RIVER NEAR THREE FORKS	11	Average	2046	1897	1604	1313	1269	1432	1662	2204	2848	1679	1238	1495	1724
		10	2845	2446	2040	1577	1536	1731	2167	3033	4044	2523	1707	1952	2300
		20	2446	2023	1959	1549	1489	1548	1853	2602	3756	1933	1647	1898	2059
		50	1924	1794	1609	1302	1302	1451	1646	2011	2731	1715	1227	1393	1675
		80	1739	1590	1265	1102	1045	1262	1432	1759	2020	1223	724	1189	1362
		90	1676	1525	1176	1033	969	1078	1160	1636	1690	823	602	1124	1208
MISSOURI RIVER AT TOSTON	12	Average	4538	4769	3717	3263	3606	3967	5656	8681	11502	4719	2310	3240	4997
		10	5957	5896	4334	4031	4270	4786	7377	13161	17817	8133	3741	4715	7018
		20	5531	5491	4160	3708	3959	4614	6839	11225	16582	6289	3065	4167	6303
		50	4240	4500	3680	3246	3566	3909	5242	8320	11468	4410	2251	3113	4829
		80	3382	3943	3245	2748	3240	3368	4290	5378	6627	2154	1280	2269	3494
		90	3120	3747	3041	2570	2935	2957	3835	4771	5536	1824	829	1846	3084
MISSOURI RIVER INFLOWS TO CANYON FERRY RESERVOIR	13	Average	4665	4875	3742	3353	3702	4386	5751	8945	11561	4658	2193	3342	5098
		10	6560	6135	4592	4203	4585	5430	7494	14144	18762	7870	3736	4878	7366
		20	5790	5658	4218	3912	4206	5012	7076	11776	16385	7075	3136	4484	6561
		50	4459	4695	3779	3389	3759	4301	5323	8320	11365	4175	2087	3159	4901
		80	3320	4139	3233	2725	3061	3723	4546	5570	5971	2095	1071	2313	3480
		90	3219	3572	2546	2322	2446	3440	3710	4547	4785	1377	692	1808	2872
CANYON FEERY RESERVOIR OUTFLOWS TO MISSOURI RIVER	14	Average	4619	4668	4689	4172	4356	5360	5795	6205	6049	4959	3718	3812	4867
		10	5511	5628	5846	5880	6000	8170	8810	9457	9214	7837	5460	5473	6941
		20	5373	5459	5577	5362	5591	6807	7399	8003	7750	6416	4603	4695	6086
		50	4831	4830	4835	4080	4172	5289	5777	6276	6067	4357	2928	3026	4706
		80	3901	3900	3905	2928	3242	2928	3142	3373	3287	2928	2928	3026	3291
		90	2928	3026	2928	2928	3242	2928	3026	2928	3026	2928	2928	3026	2987
HAUSER LAKE OUTLFOWS TO MISSOURI RIVER	15	Average	4624	4641	4717	4228	4353	5384	5772	6137	5969	4853	3661	3822	4847
		10	5513	5586	5847	5873	6001	8110	8829	9403	9144	7673	5416	5491	6907
		20	5412	5442	5587	5360	5635	6812	7371	7959	7673	6308	4550	4606	6060
		50	4819	4766	4863	4071	4218	5402	5803	6256	6028	4157	2937	3231	4712
		80	3784	3893	3907	2984	3257	3037	3264	3347	3071	2820	2832	2996	3266
		90	3068	3009	3028	2919	3169	2925	3011	2797	2926	2750	2791	2952	2946
MISSOURI RIVER INFLOWS TO HOLTER LAKE	16	Average	4642	4637	4732	4286	4403	5452	5831	6258	6165	4782	3607	3867	4889
		10	5581	5648	5856	5956	6055	8056	8569	9522	9607	8012	5282	5623	6981
		20	5412	5451	5510	5427	5663	6835	7386	8384	8510	6168	4528	4695	6164
		50	4877	4812	4904	4113	4101	5393	5905	6169	5884	3966	3100	3322	4712
		80	3798	3871	3918	3021	3299	3356	3791	3582	3878	2760	2733	2982	3416
		90	3060	2889	3101	2876	3077	2895	2952	2834	2856	2635	2641	2917	2894

Baseline conditions (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
HOLTER LAKE	17	Average	4611	4638	4820	4376	4489	5435	5773	6114	6078	4819	3645	3873	4889
OUTFLOWS		10	5638	5728	5883	5999	6195	7850	8851	9532	9575	8118	5349	5559	7023
TO MISSOURI		20	5393	5453	5581	5564	5664	7028	7316	8336	8344	6130	4495	4752	6171
RIVER		50	4790	4815	4959	4209	4302	5364	5651	5816	5747	3964	3135	3428	4682
		80	3727	3823	3901	3048	3318	3270	3876	3638	3601	2902	2769	2997	3406
		90	2885	2922	3342	2814	3002	2779	3048	2611	2935	2758	2624	2817	2878
SMITH RIVER	18	Average	172	152	124	96	140	170	414	975	992	407	141	139	327
NEAR		10	330	260	241	151	243	265	699	1755	2233	884	283	258	633
EDEN		20	238	185	168	137	173	228	566	1481	1209	635	202	169	449
		50	140	129	105	93	124	156	339	793	796	302	124	106	267
		80	110	102	62	58	80	102	210	487	434	129	56	62	158
		90	87	87	23	38	63	83	179	345	304	60	24	50	112
MISSOURI	19	Average	5128	5185	5330	4955	5075	6176	7008	8862	8959	5913	3943	4206	5895
RIVER NEAR		10	6511	6571	6557	6511	7076	8699	10205	12818	13561	10001	5940	6238	8391
ULM		20	6087	5953	6047	6238	6284	7878	8857	11533	11557	7855	5003	5176	7372
		50	5096	5229	5377	4891	4856	6415	6843	8676	8470	4960	3372	3616	5650
		80	3975	4188	4442	3655	3630	3751	4704	6039	5298	3146	2781	3186	4066
		90	3349	3379	3591	3417	3299	3407	3465	4588	4482	2921	2661	2968	3461
MUDDY	20	Average	110	62	45	34	38	57	42	139	240	262	293	180	125
CREEK		10	145	73	57	49	58	100	57	210	343	369	390	254	176
AT		20	131	71	52	43	49	68	47	170	290	345	369	227	155
VAUGHN		50	109	63	44	34	35	39	35	128	226	255	306	183	122
		80	86	50	35	25	27	32	30	96	174	175	212	128	89
		90	77	48	30	21	22	29	28	67	154	141	175	104	75
SUN RIVER	21	Average	383	329	289	249	264	332	453	1567	2588	644	509	434	670
NEAR		10	503	451	433	342	388	662	920	2885	5038	1374	716	584	1191
VAUGHN		20	445	385	341	305	331	438	688	2397	3450	1125	670	541	926
		50	362	299	260	240	237	272	308	1481	1943	430	493	426	563
		80	282	244	199	171	187	200	184	535	1019	240	312	303	323
		90	234	203	181	131	148	159	152	320	736	42	224	239	231
MISSOURI	22	Average	5707	5499	5428	5037	5338	6610	7545	10398	11100	6586	4554	4689	6541
RIVER AT		10	7115	7187	6793	7054	7244	9504	10719	15787	17362	10834	6831	6610	9420
BLACK EAGLE		20	6683	6601	6385	6555	6740	8514	9389	13134	13913	9180	5912	5876	8240
DAM		50	5776	5416	5566	4893	5064	6568	7419	10031	10265	5789	3951	4230	6247
		80	4461	4437	4597	3668	3757	4023	5232	6660	6498	3506	3222	3583	4470
		90	3799	3455	3515	3204	3356	3636	3908	5738	4862	3097	3005	3323	3742
MISSOURI	23	Average	6057	5849	5778	5387	5688	6960	7895	10748	11450	6936	4904	5039	6891
RIVER BELOW		10	7465	7537	7143	7404	7594	9854	11069	16137	17712	11184	7181	6960	9770
MORONY		20	7033	6951	6735	6905	7090	8864	9739	13484	14263	9530	6262	6226	8590
DAM		50	6126	5766	5916	5243	5414	6918	7769	10381	10615	6139	4301	4580	6597
		80	4811	4787	4947	4018	4107	4373	5582	7010	6848	3856	3572	3933	4820
		90	4149	3805	3865	3554	3706	3986	4258	6088	5212	3447	3355	3673	4092
MISSOURI	24	Average	5913	5863	5826	5467	5802	7067	8103	11437	12451	7159	4905	5083	7090
RIVER AT		10	7417	7546	7262	7487	7720	10025	11261	17516	20204	11789	7173	7244	10220
FORT BENTON		20	7089	6814	6898	7055	7455	9398	10156	14562	15793	9405	6080	6235	8912
		50	5696	5765	5859	5376	5585	7128	7931	11042	11541	6104	4318	4629	6748
		80	4610	4783	4879	3993	4113	4412	5701	7446	7206	3814	3543	3905	4867
		90	3823	3783	3878	3548	3680	4001	4285	6243	5596	3544	3364	3620	4114

Baseline conditions (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
TETON RIVER NEAR LOMA	25	Average	51	230	169	140	205	509	478	852	1289	392	99	75	374
		10	229	705	411	310	548	1208	1149	2163	2385	1282	277	190	905
		20	53	205	251	229	322	676	839	1708	1638	640	41	105	559
		50	0	0	99	63	111	336	303	384	795	42	0	0	178
		80	0	0	0	0	0	111	0	0	54	0	0	0	14
		90	0	0	0	0	0	32	0	0	0	0	0	0	3
MARIAS RIVER INFLOWS TO TIBER RESERVOIR	26	Average	358	355	282	249	354	743	1128	2618	3148	1019	348	278	907
		10	686	606	581	450	720	1514	2014	3851	5963	1950	664	582	1632
		20	487	465	380	319	423	962	1415	3554	4049	1405	504	461	1202
		50	279	292	221	221	259	468	1058	2407	2487	856	316	215	757
		80	148	177	143	127	158	310	498	1804	1452	399	95	82	449
		90	119	153	123	105	108	254	440	1311	1229	149	0	0	333
TIBER RESERVOIR OUTLOWS TO MARIAS RIVER	27	Average	961	767	766	766	768	554	707	815	903	1221	1221	1222	889
		10	1524	1219	1219	1219	1219	839	1120	1454	1619	2025	2025	2025	1459
		20	1279	1023	1023	1023	1023	658	937	1033	1106	1570	1570	1570	1151
		50	956	765	765	765	765	455	482	476	471	1132	1132	1132	775
		80	577	461	461	461	461	455	471	455	471	750	750	750	544
		90	423	339	339	339	339	455	471	455	471	513	513	513	431
MARIAS RIVER NEAR LOMA	28	Average	943	680	562	530	599	477	834	1091	1250	1168	1030	970	844
		10	1368	1116	982	981	1039	911	1495	1690	2840	2011	1855	1820	1509
		20	1223	906	839	830	894	705	1298	1547	1873	1841	1563	1339	1238
		50	932	694	625	491	613	399	708	1088	935	1079	1012	782	780
		80	590	362	160	184	237	198	363	509	464	596	472	426	380
		90	504	308	100	109	159	123	234	384	234	228	366	287	253
MISSOURI RIVER AT VIRGELLE	29	Average	6678	6772	6557	6137	6605	8053	9185	13147	14748	8466	5791	5894	8170
		10	8471	8642	8404	8229	9055	11549	13015	18994	21943	13944	8422	8585	11605
		20	8034	7931	7741	7966	8140	10380	11734	17325	18929	12074	7271	7287	10401
		50	6609	6742	6729	6062	6543	8165	8968	12577	13252	7323	5399	5162	7794
		80	5363	5610	5382	4265	4451	5025	6521	8930	8145	4414	3879	4356	5528
		90	4310	4712	4008	3716	4228	4535	4890	7340	6192	3986	3683	4127	4644
MOUTH OF JUDITH RIVER	30	Average	380	393	391	412	478	514	502	538	583	549	440	409	466
		10	574	598	602	639	705	752	835	812	914	799	712	657	717
		20	540	567	584	591	637	704	719	740	763	717	664	623	654
		50	313	331	276	365	510	536	451	528	557	520	372	268	419
		80	238	242	241	243	245	299	292	302	294	308	238	238	265
		90	235	241	239	241	241	244	257	252	264	266	226	236	245
MISSOURI RIVER NEAR LANDUSKY	31	Average	7132	7320	7003	6529	7150	9308	10297	14168	16611	9583	6308	6379	8982
		10	8826	8825	8709	9164	10042	13577	15240	21918	25479	15545	9097	9202	12969
		20	8663	8372	8558	8211	9351	11672	13498	17980	20582	13371	7952	7923	11345
		50	7045	7296	7169	6460	7171	9069	9669	13826	15554	8313	5875	5639	8591
		80	5757	6253	5681	4545	4762	5735	7220	9440	8989	4972	4100	4799	6021
		90	4525	5411	4118	3997	4411	5251	5511	7917	6781	4323	3907	4368	5043
MUSSELSHELL RIVER AT MOSBY	32	Average	74	90	76	81	203	518	349	596	939	314	107	112	288
		10	159	162	162	168	449	1009	937	1542	2537	924	269	279	716
		20	107	133	127	119	225	620	540	859	1623	452	194	159	430
		50	59	67	59	64	107	272	181	304	572	125	75	66	163
		80	4	18	17	18	36	110	60	80	121	32	13	14	44
		90	0	0	0	0	12	49	46	17	46	2	0	0	14

Baseline conditions (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
BIG DRY CREEK NEAR MOUTH	33	Average	5	3	2	3	56	317	90	32	80	54	19	17	56
		10	11	6	4	3	206	1042	79	90	264	122	29	13	156
		20	5	4	2	1	64	625	47	21	124	46	13	5	80
		50	2	2	1	0	3	84	11	8	25	8	3	2	12
		80	0	1	0	0	0	9	4	3	3	1	1	0	2
		90	0	0	0	0	0	4	3	1	2	1	0	0	1
MISSOURI RIVER INFLOWS TO FORT PECK RESERVOIR	34	Average	7132	6759	6204	6298	7910	13330	12039	14835	17984	10200	6582	6670	9662
		10	9758	9392	8189	9125	11672	20162	18200	22107	28932	17384	10218	10269	14617
		20	8554	8446	7481	8314	10345	15343	14615	19184	22557	13171	8459	8390	12072
		50	6991	6391	6009	6122	7433	11503	10268	13742	16958	8893	6204	5783	8858
		80	5315	4871	4405	4401	5155	6410	7202	9082	10558	5390	3979	4406	5931
		90	4312	3795	3947	3559	4009	5489	5722	6458	7380	4612	3435	4140	4738
FORT PECK RESERVOIR OUTFLOWS TO MISSOURI RIVER	35	Average	8196	9375	11873	8090	8008	6014	5569	5895	7252	11237	10145	9506	8430
		10	10617	12232	15001	14205	13642	9669	8831	9535	12273	14005	12246	11940	12016
		20	9889	11378	14852	12553	12389	8828	8055	8686	11118	13183	11705	11073	11142
		50	8115	9295	12067	7165	7048	5007	4535	4829	5872	11213	9928	9396	7873
		80	6410	7293	9390	3582	3495	2928	3026	2928	3026	9251	8159	7631	5593
		90	5635	6384	8174	2928	3242	2928	3026	2928	3026	8254	7260	6926	5059

MUNICIPAL ALTERNATIVE

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
BIG HOLE RIVER NEAR MELROSE	1	Average	518	505	395	349	365	462	1537	3499	4228	1435	450	367	1176
		10	797	684	526	456	482	706	2428	5534	6588	2448	774	593	1835
		20	673	617	457	420	415	530	2068	4549	5903	2024	668	514	1570
		50	469	474	355	347	341	399	1300	3156	4072	1409	450	324	1092
		80	333	360	287	254	289	337	890	2002	2497	666	204	207	694
		90	269	318	269	215	249	312	666	1870	1272	368	47	135	499
BEAVERHEAD RIVER ABOVE DILLON	2	Average	261	285	250	206	207	227	273	398	581	456	424	305	323
		10	456	473	385	308	298	349	487	719	980	768	775	508	542
		20	380	393	332	250	268	308	393	650	841	716	651	424	467
		50	217	280	245	206	209	215	214	345	537	497	390	243	300
		80	109	130	139	112	115	125	140	134	211	168	120	128	136
		90	87	96	94	84	99	102	96	86	123	15	17	70	81
BEAVERHEAD RIVER NEAR TWIN BRIDGES	3	Average	421	571	511	422	444	495	494	306	447	392	312	401	435
		10	728	792	678	560	560	626	820	611	915	726	548	640	684
		20	590	676	602	498	507	562	641	505	676	642	475	568	579
		50	410	559	496	416	437	494	447	206	348	386	308	386	408
		80	156	423	395	325	363	377	311	100	72	41	61	128	229
		90	106	347	338	263	325	348	263	51	0	0	0	91	178
MOUTH OF RUBY RIVER	4	Average	238	231	179	144	135	165	198	227	304	120	68	224	186
		10	301	295	238	180	168	226	331	405	609	330	195	305	299
		20	289	275	209	166	148	209	283	352	530	223	134	283	258
		50	242	232	167	138	130	149	176	208	236	89	40	221	169
		80	180	186	153	121	115	116	102	89	50	0	0	168	107
		90	152	165	147	118	109	109	92	40	0	0	0	154	90
JEFFERSON RIVER NEAR TWIN BRIDGES	5	Average	1283	1468	1242	1062	1101	1229	2325	3863	5201	1901	730	990	1866
		10	1869	1875	1518	1306	1328	1634	3333	6269	8071	3436	1336	1468	2787
		20	1622	1724	1395	1205	1235	1422	3034	5137	7176	2775	1079	1277	2423
		50	1270	1420	1210	1053	1071	1164	2030	3466	5108	1809	739	931	1773
		80	871	1203	1044	904	930	1010	1506	2311	2862	723	201	657	1185
		90	723	1086	977	804	845	921	1326	2020	1631	274	0	461	922
JEFFERSON RIVER NEAR THREE FORKS	6	Average	1789	1895	1459	1319	1347	1649	2567	4332	6396	1914	796	1283	2229
		10	2597	2381	1933	1621	1846	2025	3498	6911	10700	3591	1694	1921	3393
		20	2231	2173	1714	1516	1565	1886	3135	6017	9447	2678	1160	1643	2930
		50	1806	1893	1456	1334	1339	1638	2610	3970	6180	1748	727	1191	2158
		80	1146	1519	1137	1087	1034	1395	1688	2242	2913	523	172	866	1310
		90	966	1369	990	980	831	1317	1447	1811	2125	247	0	597	1057
GALLATIN RIVER NEAR LOGAN	7	Average	748	813	746	680	709	820	1072	2082	3052	1394	691	637	1120
		10	1117	1096	927	861	854	1001	1426	3170	4733	2099	993	976	1605
		20	991	991	864	799	809	926	1291	2686	4262	1877	888	851	1436
		50	812	814	763	689	719	809	996	2092	3066	1306	638	630	1111
		80	489	659	610	567	578	706	798	1233	1672	871	485	453	760
		90	340	458	507	480	496	619	703	1043	1305	652	387	220	601
MADISION RIVER INFLOWS TO HEBGEN RESERVOIR	8	Average	863	880	799	776	758	754	929	1666	1926	993	804	826	998
		10	1060	1094	1012	917	899	945	1223	2278	3118	1467	1079	1115	1351
		20	949	956	925	894	846	862	1052	2021	2533	1325	1007	960	1194
		50	808	786	791	758	772	754	881	1594	1814	938	758	762	952
		80	696	655	646	665	663	629	756	1241	1189	700	626	640	759
		90	634	609	585	611	600	583	716	1133	1002	616	579	590	688

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
HEBGEN RESERVOIR OUTFLOWS TO MADISON RIVER	9	Average	1462	1405	872	782	705	815	991	1053	1193	973	883	1102	1020
		10	1955	1815	1106	923	837	1046	1373	1594	1684	1366	1273	1511	1374
		20	1688	1596	990	898	780	923	1138	1265	1389	1233	1226	1437	1214
		50	1308	1290	853	762	712	796	963	1037	1100	1023	851	998	974
		80	1204	1098	700	672	611	684	811	715	968	642	536	780	785
		90	1175	1044	638	611	564	565	710	703	913	413	472	735	712
MADISON RIVER BELOW ENNIS LAKE	10	Average	2016	2079	1412	1280	1240	1429	1561	2130	2797	1773	1381	1579	1723
		10	2778	2708	1713	1565	1486	1715	2075	2972	3842	2382	1772	2054	2255
		20	2374	2476	1631	1502	1438	1548	1781	2571	3638	1980	1763	2023	2060
		50	1877	1949	1381	1247	1270	1456	1600	1872	2606	1844	1408	1437	1662
		80	1712	1706	1208	1064	1063	1265	1328	1723	2098	1329	959	1261	1393
		90	1646	1557	1127	999	1020	1131	1107	1388	1659	931	791	1183	1211
MADISON RIVER NEAR THREE FORKS	11	Average	2045	1897	1604	1313	1269	1432	1662	2204	2847	1679	1238	1495	1724
		10	2844	2446	2040	1577	1536	1731	2167	3033	4044	2522	1707	1952	2300
		20	2446	2023	1958	1549	1489	1548	1853	2602	3756	1932	1647	1898	2059
		50	1924	1794	1609	1302	1302	1451	1646	2011	2731	1715	1227	1393	1675
		80	1739	1590	1264	1102	1045	1262	1432	1759	2020	1223	724	1189	1362
		90	1676	1525	1176	1033	969	1078	1160	1636	1690	822	602	1124	1208
MISSOURI RIVER AT TOSTON	12	Average	4538	4769	3717	3262	3606	3967	5656	8681	11502	4719	2310	3240	4997
		10	5956	5896	4334	4031	4270	4786	7377	13161	17816	8133	3741	4714	7018
		20	5531	5491	4160	3708	3959	4614	6839	11224	16582	6289	3065	4167	6302
		50	4240	4500	3680	3246	3566	3909	5242	8320	11468	4410	2250	3112	4829
		80	3382	3943	3245	2748	3240	3368	4290	5378	6627	2154	1280	2268	3494
		90	3119	3747	3041	2570	2935	2957	3835	4771	5536	1824	829	1846	3084
MISSOURI RIVER INFLOWS TO CANYON FERRY RESERVOIR	13	Average	4665	4875	3742	3353	3702	4386	5751	8944	11561	4658	2193	3342	5098
		10	6560	6135	4592	4203	4585	5430	7494	14144	18762	7870	3736	4877	7366
		20	5790	5658	4217	3912	4206	5012	7076	11775	16385	7075	3136	4484	6560
		50	4459	4695	3779	3389	3759	4301	5323	8320	11364	4175	2087	3159	4901
		80	3320	4139	3233	2724	3061	3723	4546	5570	5971	2094	1071	2312	3480
		90	3219	3572	2546	2322	2446	3440	3710	4547	4785	1377	692	1808	2872
CANYON FEERY RESERVOIR OUTFLOWS TO MISSOURI RIVER	14	Average	4619	4668	4689	4172	4356	5359	5795	6205	6049	4959	3718	3812	4867
		10	5511	5628	5846	5880	6000	8169	8810	9457	9213	7837	5460	5473	6940
		20	5373	5459	5577	5362	5590	6807	7398	8003	7750	6416	4603	4695	6086
		50	4831	4830	4835	4080	4172	5289	5777	6276	6067	4357	2928	3026	4706
		80	3901	3900	3905	2928	3242	2928	3141	3373	3287	2928	2928	3026	3291
		90	2928	3026	2928	2928	3242	2928	3026	2928	3026	2928	2928	3026	2987
HAUSER LAKE OUTLFOWS TO MISSOURI RIVER	15	Average	4624	4640	4717	4227	4353	5384	5772	6137	5969	4853	3661	3822	4847
		10	5513	5586	5848	5872	6001	8110	8829	9403	9144	7673	5415	5491	6907
		20	5412	5442	5587	5360	5635	6812	7371	7958	7673	6308	4550	4606	6059
		50	4819	4766	4862	4071	4217	5402	5803	6256	6028	4157	2937	3231	4712
		80	3784	3893	3907	2984	3257	3037	3264	3347	3071	2820	2832	2996	3266
		90	3068	3009	3028	2919	3169	2925	3011	2797	2926	2750	2791	2952	2945
MISSOURI RIVER INFLOWS TO HOLTER LAKE	16	Average	4642	4637	4732	4286	4403	5452	5831	6258	6165	4782	3607	3867	4888
		10	5581	5648	5855	5956	6055	8056	8569	9522	9607	8012	5282	5623	6980
		20	5411	5451	5510	5427	5663	6835	7386	8384	8509	6168	4528	4695	6164
		50	4877	4812	4904	4113	4101	5392	5905	6169	5884	3966	3100	3322	4712
		80	3797	3871	3918	3021	3299	3356	3791	3581	3878	2760	2733	2982	3416
		90	3060	2889	3101	2876	3077	2895	2952	2834	2856	2635	2641	2917	2894

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AV
HOLTER LAKE OUTFLOWS TO MISSOURI RIVER	17	Average	4611	4638	4820	4376	4489	5435	5773	6113	6078	4819	3645	3872	488
		10	5638	5728	5883	5998	6195	7850	8851	9532	9575	8118	5349	5559	702
		20	5393	5453	5581	5564	5664	7028	7316	8336	8343	6130	4495	4752	617
		50	4790	4815	4959	4209	4302	5364	5651	5816	5747	3964	3135	3428	468
		80	3727	3823	3901	3048	3318	3270	3876	3638	3601	2902	2769	2997	340
		90	2885	2922	3342	2814	3002	2779	3048	2611	2935	2758	2624	2817	287
SMITH RIVER NEAR EDEN	18	Average	172	152	124	96	140	170	414	975	992	407	141	139	32
		10	330	260	241	151	243	265	699	1755	2233	884	283	258	63
		20	238	185	168	137	173	228	566	1481	1209	635	202	169	44
		50	140	129	105	93	124	156	339	793	796	302	124	106	26
		80	110	102	62	58	80	102	210	487	434	129	56	62	15
		90	87	87	23	38	63	83	179	345	304	60	24	50	11
MISSOURI RIVER NEAR ULM	19	Average	5128	5185	5330	4955	5075	6176	7007	8862	8959	5913	3943	4206	589
		10	6511	6571	6557	6511	7076	8699	10205	12818	13561	10001	5940	6238	839
		20	6087	5953	6047	6238	6284	7878	8856	11533	11556	7855	5003	5176	737
		50	5096	5229	5377	4891	4856	6415	6843	8676	8470	4960	3372	3616	565
		80	3975	4188	4442	3655	3630	3751	4704	6039	5297	3146	2781	3186	406
		90	3349	3379	3591	3417	3299	3407	3465	4588	4482	2921	2661	2968	346
MUDDY CREEK AT VAUGHN	20	Average	110	62	45	34	38	57	42	139	240	262	293	180	12
		10	145	73	57	49	58	100	57	210	343	369	390	254	17
		20	131	71	52	43	49	68	47	170	290	345	369	227	15
		50	109	63	43	34	35	39	35	128	226	255	306	183	12
		80	86	50	35	25	27	32	30	96	174	175	212	128	8
		90	77	48	30	21	22	29	28	67	154	141	175	104	7
SUN RIVER NEAR VAUGHN	21	Average	383	329	289	249	264	332	453	1567	2588	644	509	434	67
		10	503	451	433	342	388	662	920	2885	5038	1374	716	584	119
		20	445	385	341	305	331	438	688	2397	3450	1125	670	541	92
		50	362	299	259	240	237	272	308	1481	1943	430	493	426	56
		80	282	244	199	171	187	200	184	535	1019	240	312	303	32
		90	234	203	181	131	148	159	152	320	736	42	224	239	23
MISSOURI RIVER AT BLACK EAGLE DAM	22	Average	5707	5499	5428	5037	5338	6610	7544	10398	11100	6586	4554	4688	654
		10	7114	7187	6793	7054	7244	9504	10718	15787	17362	10834	6831	6610	942
		20	6683	6601	6385	6554	6740	8514	9389	13134	13913	9179	5911	5876	824
		50	5776	5416	5566	4893	5063	6568	7419	10031	10265	5789	3951	4230	624
		80	4461	4437	4596	3668	3757	4023	5232	6660	6498	3506	3222	3583	447
		90	3799	3455	3515	3204	3356	3636	3908	5738	4862	3097	3005	3323	374
MISSOURI RIVER BELOW MORONY DAM	23	Average	6057	5849	5778	5387	5688	6960	7894	10748	11450	6936	4904	5038	689
		10	7464	7537	7143	7404	7594	9854	11068	16137	17712	11184	7180	6960	977
		20	7033	6951	6735	6904	7090	8863	9739	13484	14263	9529	6261	6226	859
		50	6126	5766	5916	5243	5413	6918	7769	10381	10615	6139	4301	4580	659
		80	4811	4787	4946	4018	4107	4373	5582	7010	6848	3856	3572	3933	482
		90	4149	3805	3865	3554	3706	3986	4258	6088	5212	3447	3355	3673	409
MISSOURI RIVER AT FORT BENTON	24	Average	5913	5863	5826	5467	5801	7067	8103	11437	12450	7159	4905	5083	709
		10	7417	7546	7262	7487	7720	10025	11261	17516	20204	11788	7173	7244	1022
		20	7089	6814	6898	7055	7455	9398	10156	14562	15793	9405	6080	6235	891
		50	5696	5765	5859	5376	5585	7128	7931	11042	11541	6104	4318	4629	674
		80	4610	4783	4879	3993	4112	4411	5701	7446	7206	3814	3543	3905	486
		90	3823	3783	3878	3548	3680	4001	4285	6243	5596	3543	3364	3620	411

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
TETON RIVER	25	Average	51	230	169	140	205	509	478	852	1289	392	99	75	374
NEAR		10	229	705	411	310	548	1208	1149	2163	2385	1282	277	190	905
LOMA		20	53	205	251	229	322	676	839	1708	1638	640	41	105	559
		50	0	0	99	63	111	336	303	384	795	42	0	0	178
		80	0	0	0	0	0	111	0	0	54	0	0	0	14
		90	0	0	0	0	0	32	0	0	0	0	0	0	3
MARIAS RIVER	26	Average	358	355	282	249	354	743	1128	2618	3148	1019	348	278	907
INFLOWS		10	686	606	581	450	720	1514	2014	3851	5963	1950	664	582	1632
TO TIBER		20	487	465	380	319	423	962	1415	3554	4049	1405	504	461	1202
RESERVOIR		50	279	292	221	221	259	468	1058	2407	2487	856	316	215	757
		80	148	177	143	127	158	310	498	1804	1452	399	95	82	449
		90	119	153	123	105	108	254	440	1311	1229	149	0	0	333
TIBER	27	Average	961	767	766	766	768	554	707	815	903	1221	1221	1222	889
RESERVOIR		10	1524	1219	1219	1219	1219	839	1120	1454	1619	2025	2025	2025	1459
OUTLOWS		20	1279	1023	1023	1023	1023	658	937	1033	1106	1569	1569	1569	1151
TO MARIAS		50	956	765	765	765	765	455	482	476	471	1132	1132	1132	775
RIVER		80	577	461	461	461	461	455	471	455	471	750	750	750	544
		90	423	339	339	339	339	455	471	455	471	513	513	513	431
MARIAS RIVER	28	Average	943	680	562	530	599	477	834	1091	1250	1168	1030	970	844
NEAR LOMA		10	1368	1116	982	981	1039	911	1495	1690	2840	2011	1855	1820	1509
		20	1223	906	839	830	894	705	1298	1547	1873	1841	1563	1339	1238
		50	932	694	625	491	613	399	708	1088	935	1079	1012	782	780
		80	590	362	160	184	237	198	363	509	464	596	472	426	380
		90	504	308	100	109	159	123	234	384	234	228	366	287	253
MISSOURI	29	Average	6678	6772	6557	6137	6605	8052	9184	13147	14748	8466	5791	5894	8169
RIVER AT		10	8471	8642	8404	8228	9055	11549	13015	18994	21943	13944	8422	8585	11604
VIRGELLE		20	8034	7931	7741	7965	8140	10380	11734	17324	18929	12074	7270	7287	10401
		50	6609	6742	6729	6062	6542	8165	8967	12577	13252	7323	5399	5161	7794
		80	5362	5610	5381	4265	4451	5025	6521	8930	8144	4414	3879	4356	5528
		90	4310	4712	4007	3716	4228	4535	4890	7340	6192	3986	3683	4127	4644
MOUTH	30	Average	380	393	391	412	478	514	502	538	583	549	440	409	466
OF JUDITH		10	574	598	602	639	705	752	835	812	914	799	712	657	717
RIVER		20	540	567	584	591	637	704	719	740	763	717	664	623	654
		50	313	331	276	365	510	536	451	528	557	520	372	268	419
		80	238	242	241	243	245	299	292	302	294	308	238	238	265
		90	235	241	239	241	241	244	257	252	264	266	226	236	245
MISSOURI	31	Average	7131	7320	7003	6529	7149	9308	10297	14168	16611	9583	6308	6379	8982
RIVER NEAR		10	8826	8825	8709	9164	10042	13577	15240	21918	25479	15545	9096	9202	12968
LANDUSKY		20	8663	8372	8558	8210	9351	11672	13498	17980	20582	13371	7952	7923	11344
		50	7045	7296	7168	6459	7171	9069	9668	13826	15554	8313	5875	5639	8590
		80	5757	6252	5681	4545	4762	5735	7220	9439	8988	4972	4100	4799	6021
		90	4525	5411	4117	3997	4411	5251	5511	7917	6781	4323	3907	4368	5043
MUSSELSHELL	32	Average	74	90	76	81	203	518	349	596	939	314	107	112	288
RIVER AT		10	159	162	162	168	449	1009	937	1542	2537	924	269	279	716
MOSBY		20	107	133	127	119	225	620	540	859	1623	452	194	159	430
		50	59	67	59	64	107	272	181	304	572	125	75	66	163
		80	4	18	17	18	36	110	60	80	121	32	13	14	44
		90	0	0	0	0	12	49	46	17	46	2	0	0	14

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
BIG DRY CREEK NEAR MOUTH	33	Average	5	3	2	3	56	317	90	32	80	54	19	17	56
		10	11	6	4	3	206	1042	79	90	264	122	29	13	156
		20	5	4	2	1	64	625	47	21	124	46	13	5	80
		50	2	2	1	0	3	84	11	8	25	8	3	2	12
		80	0	1	0	0	0	9	4	3	3	1	1	0	2
		90	0	0	0	0	0	4	3	1	2	1	0	0	1
MISSOURI RIVER INFLOWS TO FORT PECK RESERVOIR	34	Average	7131	6759	6204	6298	7910	13330	12039	14835	17984	10200	6582	6670	9662
		10	9758	9391	8189	9125	11671	20161	18200	22107	28931	17383	10218	10269	14617
		20	8554	8446	7481	8314	10344	15343	14615	19184	22557	13171	8459	8390	12072
		50	6991	6391	6009	6122	7433	11503	10267	13742	16958	8893	6204	5783	8858
		80	5315	4871	4405	4401	5155	6410	7202	9082	10558	5390	3978	4406	5931
		90	4312	3795	3947	3559	4009	5489	5722	6458	7379	4612	3435	4140	4738
FORT PECK RESERVOIR OUTFLOWS TO MISSOURI RIVER	35	Average	8196	9375	11873	8090	8008	6014	5569	5895	7252	11237	10145	9506	8430
		10	10617	12232	15001	14205	13642	9669	8831	9535	12273	14004	12246	11940	12010
		20	9889	11378	14852	12552	12389	8828	8055	8685	11117	13183	11705	11072	11142
		50	8115	9295	12067	7165	7048	5007	4535	4829	5872	11213	9928	9396	7873
		80	6410	7293	9390	3581	3494	2928	3026	2928	3026	9251	8159	7631	5593
		90	5635	6383	8173	2928	3242	2928	3026	2928	3026	8254	7260	6926	5059

Table A-2. Percentage reductions in monthly streamflows

MUNICIPAL ALTERNATIVE

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
BIG HOLE	1	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MELROSE		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEAVERHEAD	2	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ABOVE DILLON		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEAVERHEAD	3	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TWIN		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BRIDGES		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MOUTH OF	4	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUBY RIVER		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JEFFERSON	5	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TWIN BRIDGES		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JEFFERSON	6	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
THREE FORKS		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GALLATIN	7	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00
RIVER NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.00
LOGAN		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MADISION	8	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
RIVER INFLOWS		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TO HEBGEN		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESERVOIR		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
HEBGEN RESERVOIR OUTFLOWS TO MADISON RIVER	9	Average	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MADISON RIVER BELOW ENNIS LAKE	10	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.07	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.08
MADISION RIVER NEAR THREE FORKS	11	Average	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
		10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
		20	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
MISSOURI RIVER AT TOSTON	12	Average	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
		90	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSOURI RIVER INFLOWS TO CANYON FERRY RESERVOIR	13	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
		20	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.04	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CANYON FEERY RESERVOIR OUTFLOWS TO MISSOURI RIVER	14	Average	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01
		20	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HAUSER LAKE OUTLFOWS TO MISSOURI RIVER	15	Average	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	-0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
		50	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
MISSOURI RIVER INFLOWS TO HOLTER LAKE	16	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
		10	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		20	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
HOLTER LAKE	17	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.00
OUTFLOWS		10	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TO MISSOURI		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
RIVER		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SMITH RIVER	18	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EDEN		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSOURI	19	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
RIVER NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ULM		20	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
MUDDY	20	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CREEK		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AT		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAUGHN		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUN RIVER	21	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAUGHN		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSOURI	22	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00
RIVER AT		10	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
BLACK EAGLE		20	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00
DAM		50	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
MISSOURI	23	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00
RIVER BELOW		10	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00
MORONY		20	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.02	0.00	0.00
DAM		50	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
MISSOURI	24	Average	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
RIVER AT		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
FORT BENTON		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
TETON RIVER NEAR LOMA	25	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARIAS RIVER INFLOWS TO TIBER RESERVOIR	26	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TIBER RESERVOIR OUTLOWS TO MARIAS RIVER	27	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARIAS RIVER NEAR LOMA	28	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSOURI RIVER AT VIRGELLE	29	Average	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01
		10	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		20	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00
		80	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MOUTH OF JUDITH RIVER	30	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSOURI RIVER NEAR LANDUSKY	31	Average	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
		20	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		50	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01
		80	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MUSSELSHELL RIVER AT MOSBY	32	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Municipal alternative (continued)

	MODEL NODE	% FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
BIG DRY	33	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CREEK NEAR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MOUTH		20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSOURI	34	Average	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER INFLOWS		10	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
TO FORT PECK		20	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESERVOIR		50	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
		90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
FORT PECK	35	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESERVOIR		10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
OUTFLOWS TO		20	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00
MISSOURI RIVER		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		80	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		90	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A-3. Monthly reservoir elevations, contents, and energy production

BASELINE CONDITIONS

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Hebgen Operations													
Contents (kaf)													
Average	299	267	263	262	265	262	258	296	339	341	336	319	292
10	312	269	264	263	267	276	288	334	360	372	368	351	310
20	304	268	263	263	266	270	278	320	357	370	351	321	303
50	294	267	263	262	266	261	255	300	345	329	325	313	290
80	292	266	262	262	265	252	236	267	314	317	323	310	280
90	291	265	262	262	264	248	226	258	310	314	321	304	277
Elevation (feet)													
Average	6528	6525	6524	6524	6525	6524	6524	6527	6531	6531	6531	6529	6527
10	6529	6525	6524	6524	6525	6525	6527	6531	6533	6534	6533	6532	6528
20	6528	6525	6524	6524	6525	6525	6526	6530	6533	6534	6532	6530	6528
50	6527	6525	6524	6524	6525	6524	6523	6528	6532	6530	6530	6529	6527
80	6527	6525	6524	6524	6524	6523	6522	6525	6529	6529	6530	6529	6526
90	6527	6525	6524	6524	6524	6523	6521	6524	6529	6529	6530	6528	6526
Madison Operations													
Energy Production (GWHr)													
Average	7	7	6	6	5	6	6	7	7	6	6	6	6
10	7	7	7	7	6	7	7	7	7	7	7	7	7
20	7	7	7	7	6	7	7	7	7	7	7	7	7
50	7	7	6	6	5	7	7	7	7	7	6	6	7
80	7	7	5	5	4	6	6	7	7	6	4	5	6
90	7	7	5	4	4	5	5	6	7	4	4	5	5
Toston Operations													
Energy Production (GWHr)													
Average	5	5	4	4	4	4	6	7	7	5	3	4	5
10	7	6	5	5	4	5	7	7	7	7	4	5	6
20	6	6	5	4	4	5	7	7	7	7	3	5	6
50	5	5	4	4	4	4	6	7	7	5	3	3	5
80	4	4	4	3	3	4	5	6	7	2	1	2	4
90	4	4	3	3	3	3	4	5	6	2	1	2	3
Average generation (mw)													
Average	7	7	6	5	5	6	8	9	10	6	4	5	6
10	9	9	7	6	6	7	10	10	10	10	6	7	8
20	8	8	6	6	6	7	10	10	10	9	5	6	8
50	6	7	6	5	5	6	8	10	10	7	3	5	6
80	5	6	5	4	5	5	7	8	10	3	2	3	5
90	5	6	5	4	4	4	6	7	8	3	1	3	5
Spills (kaf)													
Average	2	2	0	0	0	0	19	161	308	28	0	0	43
10	0	0	0	0	0	0	47	404	668	95	0	0	101
20	0	0	0	0	0	0	15	285	594	3	0	0	75
50	0	0	0	0	0	0	0	106	290	0	0	0	33
80	0	0	0	0	0	0	0	0	2	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0

Baseline conditions (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Canyon Ferry Operations													
Energy Production (GWh)													
Average	34	34	35	30	28	35	33	35	35	30	24	25	32
10	40	41	45	43	38	44	41	45	43	45	39	38	42
20	40	41	43	40	34	43	40	43	43	45	32	32	40
50	37	35	36	30	28	37	36	39	41	31	19	21	32
80	28	27	28	22	21	23	21	22	21	19	18	20	22
90	21	21	22	21	20	21	18	18	17	17	16	17	19
Contents (kaf)													
Average	1616	1629	1571	1520	1484	1424	1410	1552	1845	1789	1659	1613	1593
10	1808	1812	1746	1731	1750	1711	1766	1862	1947	1912	1824	1796	1805
20	1765	1788	1699	1652	1629	1623	1617	1787	1947	1912	1799	1747	1747
50	1703	1705	1644	1569	1554	1471	1428	1584	1947	1912	1759	1714	1666
80	1592	1594	1566	1499	1381	1272	1223	1375	1928	1768	1652	1608	1538
90	1262	1254	1236	1212	1168	1190	1035	1230	1660	1528	1383	1267	1285
Elevations (feet)													
Average	3786	3786	3784	3782	3781	3779	3779	3784	3793	3791	3787	3785	3785
10	3793	3793	3791	3790	3791	3789	3791	3794	3797	3796	3793	3792	3792
20	3791	3792	3789	3788	3787	3787	3787	3792	3797	3796	3792	3791	3791
50	3789	3789	3787	3785	3784	3782	3780	3785	3797	3796	3791	3790	3788
80	3786	3786	3785	3783	3779	3775	3773	3778	3796	3791	3788	3786	3784
90	3774	3774	3773	3772	3770	3771	3765	3773	3788	3784	3779	3774	3775
Spills (kaf)													
Average	6	5	3	1	1	34	49	55	43	36	0	0	19
10	21	15	12	0	0	117	154	176	168	109	0	0	64
20	10	4	0	0	0	71	113	134	77	21	0	0	36
50	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0
Hauser Operations													
Energy Production (GWHr)													
Average	12	12	12	11	10	12	12	12	12	11	10	10	11
10	13	13	13	13	12	13	13	13	13	13	13	13	13
20	13	13	13	13	12	13	13	13	13	13	13	13	13
50	13	13	13	12	11	13	13	13	13	12	8	9	12
80	11	11	11	8	8	9	9	9	8	8	8	8	9
90	9	8	9	8	8	8	8	8	8	8	8	8	8
Holter Operations													
Energy Production (GWHr)													
Average	26	25	27	24	23	29	30	31	30	25	20	21	26
10	31	31	33	33	31	42	40	42	40	42	30	30	36
20	30	29	31	31	29	39	40	42	40	34	25	26	33
50	27	26	28	23	22	30	31	32	31	22	17	19	26
80	21	21	22	17	17	18	21	20	19	16	15	16	19
90	16	16	19	16	15	16	16	15	16	15	15	15	16

Baseline conditions (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Tiber Operations													
Contents (kaf)													
Average	807	783	753	721	698	710	735	845	979	967	913	857	814
10	881	843	795	746	699	756	816	933	1266	1220	1110	1014	923
20	853	818	779	736	699	729	772	908	1023	1031	981	916	854
50	803	778	751	724	699	698	728	846	967	945	891	834	805
80	749	741	718	702	699	684	689	770	876	855	804	775	755
90	720	712	704	694	699	669	672	733	793	788	758	726	722
Elevations (feet)													
Average	2983	2982	2980	2978	2976	2977	2978	2986	2993	2992	2989	2986	2983
10	2988	2986	2983	2979	2976	2980	2984	2991	3008	3006	3001	2996	2990
20	2986	2984	2982	2979	2976	2978	2981	2990	2996	2996	2994	2990	2986
50	2983	2981	2980	2978	2976	2976	2978	2986	2993	2992	2989	2985	2983
80	2980	2979	2977	2976	2976	2975	2975	2981	2988	2986	2983	2981	2980
90	2977	2977	2976	2976	2976	2974	2974	2978	2982	2982	2980	2978	2978
MPC's Great Falls Facilities Operations													
Black Eagle Energy Production (GWHr)													
Average	13	13	13	12	11	13	13	13	13	12	11	11	12
10	14	13	14	14	12	14	13	14	13	14	14	13	14
20	14	13	14	14	12	14	13	14	13	14	14	13	14
50	14	13	14	13	12	14	13	14	13	14	11	11	13
80	12	12	13	10	9	11	13	14	13	10	9	10	11
90	10	9	10	9	8	10	10	14	13	9	8	9	10
Rainbow Energy Production (GWHr)													
Average	25	24	25	23	21	24	24	26	25	23	22	22	24
10	26	25	26	26	24	26	25	26	25	26	26	25	26
20	26	25	26	26	24	26	25	26	25	26	26	25	26
50	26	25	26	25	24	26	25	26	25	26	21	21	25
80	23	22	24	19	18	21	25	26	25	19	17	18	22
90	20	18	19	17	16	19	20	26	24	17	16	17	19
Cochrane Energy Production (GWHr)													
Average	26	24	25	23	22	29	31	37	36	27	21	21	27
10	32	31	30	31	29	42	41	42	41	42	30	29	35
20	30	29	29	29	27	38	40	42	41	40	27	26	33
50	26	24	25	22	21	29	32	42	41	26	18	19	27
80	20	20	21	17	16	19	23	30	28	16	15	16	20
90	18	16	16	15	14	17	17	26	21	15	14	15	17
Ryan Energy Production (GWHr)													
Average	41	39	40	37	35	41	41	43	42	38	35	34	39
10	45	43	45	45	40	45	43	45	43	45	45	43	44
20	45	43	45	45	40	45	43	45	43	45	45	43	44
50	45	42	44	39	36	45	43	45	43	45	32	33	41
80	36	34	37	30	28	33	40	45	43	29	27	28	34
90	31	27	29	26	25	30	31	44	38	26	25	26	30
Morony Energy Production (GWHr)													
Average	27	25	26	24	23	29	30	33	32	26	22	22	27
10	33	33	32	33	31	36	34	36	34	36	32	30	33
20	31	30	30	31	29	36	34	36	34	36	28	27	32
50	27	25	26	23	22	31	34	36	34	27	19	20	27
80	21	21	22	18	17	20	24	31	30	17	16	17	21
90	18	16	17	16	15	18	18	27	23	15	15	16	18

Baseline conditions (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Fort Peck Operations													
Energy Production (GWHr)													
Average	85	93	119	82	73	61	56	61	72	116	103	95	85
10	109	120	147	138	120	96	86	97	121	143	127	119	119
20	102	112	146	124	110	89	79	89	111	136	121	111	111
50	84	92	121	74	66	54	48	53	61	116	103	94	80
80	67	73	95	39	34	32	32	32	33	97	85	77	58
90	60	65	83	32	32	32	32	32	32	87	76	70	53
Contents (kaf)													
Average	16766	16526	16050	15910	15894	16325	16689	17193	17760	17600	17260	16976	16746
10	17250	16937	16345	16272	16450	16874	17204	17657	17910	18088	17795	17441	17185
20	17087	16842	16245	16189	16326	16726	17093	17545	17902	17857	17528	17265	17050
50	16779	16566	16027	15993	16041	16442	16719	17196	17868	17604	17302	16982	16793
80	16489	16278	15897	15617	15517	15878	16243	16849	17688	17357	16949	16640	16450
90	16217	16051	15769	15411	15064	15601	15935	16594	17241	17019	16696	16443	16170
Elevations (feet)													
Average	2242	2241	2239	2238	2238	2240	2242	2244	2246	2246	2244	2243	2242
10	2244	2243	2240	2240	2241	2242	2244	2246	2247	2248	2246	2245	2244
20	2243	2242	2240	2239	2240	2242	2243	2245	2247	2247	2245	2244	2243
50	2242	2241	2239	2239	2239	2241	2242	2244	2247	2246	2244	2243	2242
80	2241	2240	2238	2237	2236	2238	2240	2242	2246	2245	2243	2241	2241
90	2240	2239	2238	2236	2234	2237	2238	2241	2244	2243	2242	2241	2239
Spills (kaf)													
Average	0	0	0	0	0	7	5	7	14	0	10	0	4
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0

MUNICIPAL ALTERNATIVE

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Hebgen Operations													
Contents (kaf)													
Average	299	267	263	262	265	262	258	296	339	341	336	319	292
10	312	269	264	263	267	276	288	334	360	372	368	351	310
20	304	268	263	263	266	270	278	320	357	370	351	321	303
50	294	267	263	262	266	261	255	300	345	329	325	313	290
80	292	266	262	262	265	252	236	267	314	317	323	310	280
90	291	265	262	262	264	248	226	258	310	314	321	304	277
Elevation (feet)													
Average	6528	6525	6524	6524	6525	6524	6524	6527	6531	6531	6531	6529	6527
10	6529	6525	6524	6524	6525	6525	6527	6531	6533	6534	6533	6532	6528
20	6528	6525	6524	6524	6525	6525	6526	6530	6533	6534	6532	6530	6528
50	6527	6525	6524	6524	6525	6524	6523	6528	6532	6530	6530	6529	6527
80	6527	6525	6524	6524	6524	6523	6522	6525	6529	6529	6530	6529	6526
90	6527	6525	6524	6524	6524	6523	6521	6524	6529	6529	6530	6528	6526
Madison Operations													
Energy Production (GWHr)													
Average	7	7	6	6	5	6	6	7	7	6	6	6	6
10	7	7	7	7	6	7	7	7	7	7	7	7	7
20	7	7	7	7	6	7	7	7	7	7	7	7	7
50	7	7	6	6	5	7	7	7	7	7	6	6	7
80	7	7	5	5	4	6	6	7	7	6	4	5	6
90	7	7	5	4	4	5	5	6	7	4	4	5	5
Toston Operations													
Energy Production (GWHr)													
Average	5	5	4	4	4	4	6	7	7	5	3	4	5
10	7	6	5	5	4	5	7	7	7	7	4	5	6
20	6	6	5	4	4	5	7	7	7	7	3	5	6
50	5	5	4	4	4	4	6	7	7	5	3	3	5
80	4	4	4	3	3	4	5	6	7	2	1	2	4
90	4	4	3	3	3	3	4	5	6	2	1	2	3
Average generation (mw)													
Average	7	7	6	5	5	6	8	9	10	6	4	5	6
10	9	9	7	6	6	7	10	10	10	10	6	7	8
20	8	8	6	6	6	7	10	10	10	9	5	6	8
50	6	7	6	5	5	6	8	10	10	7	3	5	6
80	5	6	5	4	5	5	7	8	10	3	2	3	5
90	5	6	5	4	4	4	6	7	8	3	1	3	5
Spills (kaf)													
Average	2	2	0	0	0	0	19	161	308	28	0	0	43
10	0	0	0	0	0	0	47	404	668	95	0	0	101
20	0	0	0	0	0	0	15	285	594	3	0	0	75
50	0	0	0	0	0	0	0	106	290	0	0	0	33
80	0	0	0	0	0	0	0	0	2	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0

Municipal alternative (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Canyon Ferry Operations													
Energy Production (GWh)													
Average	34	34	35	30	28	35	33	35	35	30	24	25	32
10	40	41	45	43	38	44	41	45	43	45	39	38	42
20	40	41	43	40	34	43	40	43	43	45	32	32	40
50	37	35	36	30	28	37	36	39	41	31	19	21	32
80	28	27	28	22	21	23	21	22	21	19	18	20	22
90	21	21	22	21	20	21	18	18	17	17	16	17	19
Contents (kaf)													
Average	1616	1629	1571	1520	1484	1424	1410	1552	1845	1789	1659	1612	1593
10	1808	1812	1746	1731	1750	1711	1766	1862	1947	1912	1824	1796	1805
20	1765	1788	1699	1652	1629	1623	1617	1787	1947	1912	1799	1747	1747
50	1703	1705	1644	1569	1554	1471	1428	1584	1947	1912	1759	1714	1666
80	1592	1594	1566	1499	1381	1272	1223	1375	1927	1768	1651	1608	1538
90	1262	1254	1235	1211	1167	1189	1035	1230	1660	1528	1383	1267	1285
Elevations (feet)													
Average	3786	3786	3784	3782	3781	3779	3779	3784	3793	3791	3787	3785	3785
10	3793	3793	3791	3790	3791	3789	3791	3794	3797	3796	3793	3792	3792
20	3791	3792	3789	3788	3787	3787	3787	3792	3797	3796	3792	3791	3791
50	3789	3789	3787	3785	3784	3782	3780	3785	3797	3796	3791	3790	3788
80	3786	3786	3785	3783	3779	3775	3773	3778	3796	3791	3788	3786	3784
90	3774	3774	3773	3772	3770	3771	3765	3773	3788	3784	3779	3774	3775
Spills (kaf)													
Average	6	5	3	1	1	34	49	55	43	36	0	0	19
10	21	15	12	0	0	117	154	176	168	109	0	0	64
20	10	4	0	0	0	71	113	134	77	21	0	0	36
50	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0
Hauser Operations													
Energy Production (GWHr)													
Average	12	12	12	11	10	12	12	12	12	11	10	10	11
10	13	13	13	13	12	13	13	13	13	13	13	13	13
20	13	13	13	13	12	13	13	13	13	13	13	13	13
50	13	13	13	12	11	13	13	13	13	12	8	9	12
80	11	11	11	8	8	9	9	9	8	8	8	8	9
90	9	8	9	8	8	8	8	8	8	8	8	8	8
Holter Operations													
Energy Production (GWHr)													
Average	26	25	27	24	23	29	30	31	30	25	20	21	26
10	31	31	33	33	31	42	40	42	40	42	30	30	36
20	30	29	31	31	29	39	40	42	40	34	25	26	33
50	27	26	28	23	22	30	31	32	31	22	17	19	26
80	21	21	22	17	17	18	21	20	19	16	15	16	19
90	16	16	19	16	15	16	16	15	16	15	15	15	16

Municipal alternative (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AV
Tiber Operations													
Contents (kaf)													
Average	807	783	753	721	698	710	735	845	979	967	913	857	81
10	881	843	795	746	699	756	816	933	1266	1220	1110	1014	92
20	853	818	779	736	699	729	772	908	1023	1031	981	916	85
50	803	778	751	724	699	698	728	846	967	945	891	834	80
80	749	741	718	702	699	684	689	770	876	855	804	775	75
90	720	711	704	694	699	669	672	733	793	788	758	726	72
Elevations (feet)													
Average	2983	2982	2980	2978	2976	2977	2978	2986	2993	2992	2989	2986	298
10	2988	2986	2983	2979	2976	2980	2984	2991	3008	3006	3001	2996	299
20	2986	2984	2982	2979	2976	2978	2981	2990	2996	2996	2994	2990	298
50	2983	2981	2980	2978	2976	2976	2978	2986	2993	2992	2989	2985	298
80	2980	2979	2977	2976	2976	2975	2975	2981	2988	2986	2983	2981	298
90	2977	2977	2976	2976	2976	2974	2974	2978	2982	2982	2980	2978	297
MPC's Great Falls Facilities Operations													
Black Eagle Energy Production (GWHr)													
Average	13	13	13	12	11	13	13	13	13	12	11	11	1
10	14	13	14	14	12	14	13	14	13	14	14	13	1
20	14	13	14	14	12	14	13	14	13	14	14	13	1
50	14	13	14	13	12	14	13	14	13	14	11	11	1
80	12	12	13	10	9	11	13	14	13	10	9	10	1
90	10	9	10	9	8	10	10	14	13	9	8	9	1
Rainbow Energy Production (GWHr)													
Average	25	24	25	23	21	24	24	26	25	23	22	22	2
10	26	25	26	26	24	26	25	26	25	26	26	25	2
20	26	25	26	26	24	26	25	26	25	26	26	25	2
50	26	25	26	25	24	26	25	26	25	26	21	21	2
80	23	22	24	19	18	21	25	26	25	19	17	18	2
90	20	18	19	17	16	19	20	26	24	17	16	17	1
Cochrane Energy Production (GWHr)													
Average	26	24	25	23	22	29	31	37	36	27	21	21	2
10	32	31	30	31	29	42	41	42	41	42	30	29	3
20	30	29	29	29	27	38	40	42	41	40	27	26	3
50	26	24	25	22	21	29	32	42	41	26	18	19	2
80	20	20	21	17	16	19	23	30	28	16	15	16	2
90	18	16	16	15	14	17	17	26	21	15	14	15	1
Ryan Energy Production (GWHr)													
Average	41	39	40	37	35	41	41	43	42	38	35	34	3
10	45	43	45	45	40	45	43	45	43	45	45	43	4
20	45	43	45	45	40	45	43	45	43	45	45	43	4
50	45	42	44	39	36	45	43	45	43	45	32	33	4
80	36	34	37	30	28	33	40	45	43	29	27	28	3
90	31	27	29	26	25	30	31	44	38	26	25	26	3
Morony Energy Production (GWHr)													
Average	27	25	26	24	23	29	30	33	32	26	22	22	2
10	33	33	32	33	31	36	34	36	34	36	32	30	3
20	31	30	30	31	29	36	34	36	34	36	28	27	3
50	27	25	26	23	22	31	34	36	34	27	19	20	2
80	21	21	22	18	17	20	24	31	30	17	16	17	2
90	18	16	17	16	15	18	18	27	23	15	15	16	1

Municipal alternative (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Fort Peck Operations													
Energy Production (GWHr)													
Average	85	93	119	82	73	61	56	61	72	116	103	95	85
10	109	120	147	138	120	96	86	97	121	143	127	119	119
20	102	112	146	124	110	89	79	89	111	136	121	111	111
50	84	92	121	74	66	54	48	53	61	116	103	94	80
80	67	73	95	39	34	32	32	32	33	97	85	77	58
90	60	65	83	32	32	32	32	32	32	87	76	70	53
Contents (kaf)													
Average	16766	16526	16050	15910	15894	16325	16689	17193	17760	17600	17260	16976	16746
10	17250	16937	16345	16272	16450	16874	17204	17657	17910	18088	17795	17441	17185
20	17087	16842	16245	16189	16326	16726	17093	17545	17902	17857	17528	17265	17050
50	16779	16566	16027	15993	16041	16442	16719	17196	17868	17604	17302	16982	16793
80	16488	16278	15897	15617	15517	15878	16243	16849	17688	17357	16949	16640	16450
90	16217	16051	15769	15411	15064	15601	15935	16594	17241	17019	16696	16443	16170
Elevations (feet)													
Average	2242	2241	2239	2238	2238	2240	2242	2244	2246	2246	2244	2243	2242
10	2244	2243	2240	2240	2241	2242	2244	2246	2247	2248	2246	2245	2244
20	2243	2242	2240	2239	2240	2242	2243	2245	2247	2247	2245	2244	2243
50	2242	2241	2239	2239	2239	2241	2242	2244	2247	2246	2244	2243	2242
80	2241	2240	2238	2237	2236	2238	2240	2242	2246	2245	2243	2241	2241
90	2240	2239	2238	2236	2234	2237	2238	2241	2244	2243	2242	2241	2239
Spills (kaf)													
Average	0	0	0	0	0	7	5	7	14	0	10	0	4
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-4. Reductions to monthly reservoir elevations, contents, and energy production

BASELINE TO MUNICIPAL ALTERNATIVE

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AV
Hebgen Operations													
Contents (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Elevation (feet)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Madison Operations													
Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Toston Operations													
Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Average generation (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Spills (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Baseline to municipal alternative (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Canyon Ferry Operations													
Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Contents (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.06	0.00	0.00
90	0.00	0.00	0.08	0.08	0.09	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Elevations (feet)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spills (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hauser Operations													
Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Holter Operations													
Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Baseline to municipal alternative (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Tiber Operations													
Contents (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Elevations (feet)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MPC's Great Falls Facilities Operations													
Black Eagle Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rainbow Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cochrane Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ryan Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morony Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Baseline to municipal alternative (continued)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
Fort Peck Operations													
Energy Production (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Contents (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Elevations (feet)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spills (%)													
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A-5. Sensitivity of modeled monthly streamflows (cfs) to 10 percent increases or decreases in baseline irrigated acreages

Jefferson River near Twin Bridges

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AV
20%	Baseline Acres	1622	1724	1395	1205	1235	1422	3034	5137	7176	2775	1079	1277	242
	Baseline Acres x 1.1	1501	1643	1346	1155	1205	1391	3005	5115	7594	3450	1530	1345	252
	% Change from Baseline	-7.5	-4.7	-3.5	-4.1	-2.4	-2.2	-1.0	-0.4	5.8	24.3	41.8	5.3	4.
	Baseline Acres x 0.9	1762	1783	1456	1250	1267	1457	3061	5160	6928	2132	660	1294	235
	% Change from Baseline	8.6	3.4	4.4	3.7	2.6	2.5	0.9	0.4	-3.5	-23.2	-38.8	1.3	-3.
50%	Baseline Acres	1270	1420	1210	1053	1071	1164	2030	3466	5108	1809	739	931	177
	Baseline Acres x 1.1	1163	1333	1160	1010	1033	1137	2005	3440	5539	2548	1156	1021	187
	% Change from Baseline	-8.4	-6.1	-4.1	-4.1	-3.5	-2.3	-1.2	-0.8	8.4	40.9	56.4	9.7	6.
	Baseline Acres x 0.9	1366	1498	1270	1100	1110	1191	2057	3491	4844	1152	311	930	169
	% Change from Baseline	7.6	5.5	5.0	4.5	3.6	2.3	1.3	0.7	-5.2	-36.3	-57.9	-0.1	-4.
80%	Baseline Acres	871	1203	1044	904	930	1010	1506	2311	2862	723	201	657	118
	Baseline Acres x 1.1	748	1122	981	860	885	977	1479	2311	3211	1315	555	677	126
	% Change from Baseline	-14.1	-6.7	-6.0	-4.9	-4.8	-3.3	-1.8	0.0	12.2	81.9	176.1	3.0	6.
	Baseline Acres x 0.9	989	1282	1106	947	979	1043	1533	2288	2625	293	0	623	114
	% Change from Baseline	13.5	6.6	5.9	4.8	5.3	3.3	1.8	-1.0	-8.3	-59.5	-100.0	-5.2	-3.

Outflows from Canyon Ferry Reservoir

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20%	Baseline Acres	5373	5459	5577	5362	5591	6807	7399	8003	7750	6416	4603	4695	6086
	Baseline Acres x 1.1	5317	5378	5480	5406	5692	6859	7459	8083	7819	7542	5059	5071	6264
	% Change from Baseline	-1.0	-1.5	-1.7	0.8	1.8	0.8	0.8	1.0	0.9	17.5	9.9	8.0	2.9
	Baseline Acres x 0.9	5393	5508	5722	5350	5546	6790	7375	7968	7721	5479	4193	4432	5956
	% Change from Baseline	0.4	0.9	2.6	-0.2	-0.8	-0.2	-0.3	-0.4	-0.4	-14.6	-8.9	-5.6	-2.1
50%	Baseline Acres	4831	4830	4835	4080	4172	5289	5777	6276	6067	4357	2928	3026	4706
	Baseline Acres x 1.1	4712	4711	4716	4163	4207	5405	5895	6398	6191	5407	3378	3026	4851
	% Change from Baseline	-2.5	-2.5	-2.5	2.0	0.8	2.2	2.0	1.9	2.0	24.1	15.4	0.0	3.1
	Baseline Acres x 0.9	4821	4820	4826	3968	4157	5167	5646	6124	5929	3314	2928	3026	4560
	% Change from Baseline	-0.2	-0.2	-0.2	-2.7	-0.4	-2.3	-2.3	-2.4	-2.3	-23.9	0.0	0.0	-3.1
80%	Baseline Acres	3901	3900	3905	2928	3242	2928	3142	3373	3287	2928	2928	3026	3291
	Baseline Acres x 1.1	4092	4091	4096	2928	3242	3294	3625	3931	3824	3411	2928	3026	3541
	% Change from Baseline	4.9	4.9	4.9	0.0	0.0	12.5	15.4	16.5	16.3	16.5	0.0	0.0	7.6
	Baseline Acres x 0.9	3477	3543	3547	2928	3242	2928	3026	2928	3026	2928	2928	3026	3127
	% Change from Baseline	-10.9	-9.2	-9.2	0.0	0.0	0.0	-3.7	-13.2	-7.9	0.0	0.0	0.0	-5.0

Missouri River at Fort Benton

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AV
20%	Baseline Acres	7089	6814	6898	7055	7455	9398	10156	14562	15793	9405	6080	6235	891
	Baseline Acres x 1.1	6989	6784	6726	7095	7440	9461	10309	14653	16000	10967	6727	6645	914
	% Change from Baseline	-1.4	-0.4	-2.5	0.6	-0.2	0.7	1.5	0.6	1.3	16.6	10.6	6.6	2.
	Baseline Acres x 0.9	7210	6906	7000	7010	7454	9288	10016	14553	15493	8273	5153	5853	868
	% Change from Baseline	1.7	1.4	1.5	-0.6	-0.0	-1.2	-1.4	-0.1	-1.9	-12.0	-15.2	-6.1	-2.
50%	Baseline Acres	5696	5765	5859	5376	5585	7128	7931	11042	11541	6104	4318	4629	674
	Baseline Acres x 1.1	5632	5617	5816	5381	5629	7139	7941	11225	11708	7499	5153	4949	697
	% Change from Baseline	-1.1	-2.6	-0.7	0.1	0.8	0.2	0.1	1.7	1.4	22.9	19.3	6.9	3.
	Baseline Acres x 0.9	5710	5795	5847	5380	5373	7103	7826	10832	11212	4875	4004	4328	652
	% Change from Baseline	0.2	0.5	-0.2	0.1	-3.8	-0.4	-1.3	-1.9	-2.9	-20.1	-7.3	-6.5	-3.
80%	Baseline Acres	4610	4783	4879	3993	4113	4412	5701	7446	7206	3814	3543	3905	486
	Baseline Acres x 1.1	4915	4775	4984	3985	4160	4739	5740	7540	7356	4616	3748	3988	504
	% Change from Baseline	6.6	-0.2	2.2	-0.2	1.1	7.4	0.7	1.3	2.1	21.0	5.8	2.1	3.
	Baseline Acres x 0.9	4626	4662	4628	3911	4117	4360	5713	7428	6829	3414	3386	3800	473
	% Change from Baseline	0.3	-2.5	-5.1	-2.1	0.1	-1.2	0.2	-0.2	-5.2	-10.5	-4.4	-2.7	-2.

Missouri River inflows to Fort Peck Reservoir

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20%	Baseline Acres	8554	8446	7481	8314	10345	15343	14615	19184	22557	13171	8459	8390	12072
	Baseline Acres x 1.1	8400	8222	7587	8255	10574	15375	14790	19476	22947	15037	9211	8795	12389
	% Change from Baseline	-1.8	-2.7	1.4	-0.7	2.2	0.2	1.2	1.5	1.7	14.2	8.9	4.8	2.6
	Baseline Acres x 0.9	8558	8540	7835	8223	10491	15255	14449	19209	22214	11564	7753	7985	11840
	% Change from Baseline	0.0	1.1	4.7	-1.1	1.4	-0.6	-1.1	0.1	-1.5	-12.2	-8.3	-4.8	-1.9
50%	Baseline Acres	6991	6391	6009	6122	7433	11503	10268	13742	16958	8893	6204	5783	8858
	Baseline Acres x 1.1	6919	6614	6101	6360	7596	11523	10333	13977	17258	10913	6784	6198	9215
	% Change from Baseline	-1.0	3.5	1.5	3.9	2.2	0.2	0.6	1.7	1.8	22.7	9.3	7.2	4.0
	Baseline Acres x 0.9	6900	6571	5994	6073	7488	11475	10189	13525	16396	7575	5523	5468	8598
	% Change from Baseline	-1.3	2.8	-0.2	-0.8	0.7	-0.2	-0.8	-1.6	-3.3	-14.8	-11.0	-5.4	-2.9
80%	Baseline Acres	5315	4871	4405	4401	5155	6410	7202	9082	10558	5390	3979	4406	5931
	Baseline Acres x 1.1	5253	4812	4460	4233	5204	6841	7467	9092	11086	6219	4458	4508	6136
	% Change from Baseline	-1.2	-1.2	1.2	-3.8	1.0	6.7	3.7	0.1	5.0	15.4	12.0	2.3	3.5
	Baseline Acres x 0.9	5281	4817	4279	4207	5087	6385	7182	8959	10299	4796	3545	4245	5757
	% Change from Baseline	-0.6	-1.1	-2.9	-4.4	-1.3	-0.4	-0.3	-1.4	-2.5	-11.0	-10.9	-3.7	-2.9

Table A-6. Sensitivity of modeled monthly streamflows (cfs) to increased or decreased irrigation efficiencies

Jefferson River near Twin Bridges

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20%	Baseline Efficiencies	1622	1724	1395	1205	1235	1422	3034	5137	7176	2775	1079	1277	2423
	Baseline Increased Efficiencies	1629	1715	1392	1197	1224	1426	3034	5137	7241	2746	1093	1248	2424
	% Change from Baseline	0.4	-0.5	-0.2	-0.7	-0.9	0.3	0.0	0.0	0.9	-1.0	1.3	-2.3	0.0
	Baseline Reduced Efficiencies	1671	1726	1411	1223	1252	1420	3031	5138	7170	2787	1131	1324	2440
	% Change from Baseline	3.0	0.1	1.1	1.5	1.4	-0.1	-0.1	0.0	-0.1	0.4	4.8	3.7	0.7
50%	Baseline Efficiencies	1270	1420	1210	1053	1071	1164	2030	3466	5108	1809	739	931	1773
	Baseline Increased Efficiencies	1250	1419	1211	1045	1069	1160	2021	3469	5100	1777	753	914	1766
	% Change from Baseline	-1.6	-0.1	0.1	-0.8	-0.2	-0.3	-0.4	0.1	-0.2	-1.8	1.9	-1.8	-0.4
	Baseline Reduced Efficiencies	1290	1429	1225	1063	1075	1166	2047	3461	5161	1871	743	978	1792
	% Change from Baseline	1.6	0.6	1.2	0.9	0.4	0.2	0.8	-0.1	1.0	3.4	0.5	5.0	1.1
80%	Baseline Efficiencies	871	1203	1044	904	930	1010	1506	2311	2862	723	201	657	1185
	Baseline Increased Efficiencies	849	1195	1039	897	934	1013	1494	2311	2853	749	252	629	1185
	% Change from Baseline	-2.5	-0.7	-0.5	-0.8	0.4	0.3	-0.8	0.0	-0.3	3.6	25.4	-4.3	0.0
	Baseline Reduced Efficiencies	884	1202	1054	905	928	1019	1526	2312	2803	680	135	704	1179
	% Change from Baseline	1.5	-0.1	1.0	0.1	-0.2	0.9	1.3	0.0	-2.1	-5.9	-32.8	7.2	-0.5

Outflows from Canyon Ferry Reservoir

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20%	Baseline Efficiencies	5373	5459	5577	5362	5591	6807	7399	8003	7750	6416	4603	4695	6086
	Baseline Increased Efficiencies	5356	5406	5527	5362	5572	6808	7400	8007	7753	6615	4607	4670	6090
	% Change from Baseline	-0.3	-1.0	-0.9	0.0	-0.3	0.0	0.0	0.0	0.0	3.1	0.1	-0.5	0.1
	Baseline Reduced Efficiencies	5401	5504	5660	5373	5620	6818	7408	8009	7758	6176	4583	4752	6088
	% Change from Baseline	0.5	0.8	1.5	0.2	0.5	0.2	0.1	0.1	0.1	-3.7	-0.4	1.2	0.0
50%	Baseline Efficiencies	4831	4830	4835	4080	4172	5289	5777	6276	6067	4357	2928	3026	4706
	Baseline Increased Efficiencies	4797	4796	4801	4064	4146	5271	5757	6252	6047	4392	2928	3026	4690
	% Change from Baseline	-0.7	-0.7	-0.7	-0.4	-0.6	-0.3	-0.3	-0.4	-0.3	0.8	0.0	0.0	-0.3
	Baseline Reduced Efficiencies	4889	4888	4893	4104	4275	5317	5807	6299	6098	4225	2928	3026	4729
	% Change from Baseline	1.2	1.2	1.2	0.6	2.5	0.5	0.5	0.4	0.5	-3.0	0.0	0.0	0.5
80%	Baseline Efficiencies	3901	3900	3905	2928	3242	2928	3142	3373	3287	2928	2928	3026	3291
	Baseline Increased Efficiencies	3871	3870	3874	2928	3242	2928	3097	3329	3243	2928	2928	3026	3272
	% Change from Baseline	-0.8	-0.8	-0.8	0.0	0.0	0.0	-1.4	-1.3	-1.3	0.0	0.0	0.0	-0.6
	Baseline Reduced Efficiencies	3946	3945	3950	2928	3242	2928	3210	3441	3356	2928	2928	3026	3319
	% Change from Baseline	1.2	1.2	1.2	0.0	0.0	0.0	2.2	2.0	2.1	0.0	0.0	0.0	0.9

Missouri River at Fort Benton

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AV
20%	Baseline Efficiencies	7089	6814	6898	7055	7455	9398	10156	14562	15793	9405	6080	6235	891
	Baseline Increased Efficiencies	7069	6808	6849	7052	7454	9379	10147	14547	15792	9510	6143	6216	891
	% Change from Baseline	-0.3	-0.1	-0.7	-0.0	-0.0	-0.2	-0.1	-0.1	-0.0	1.1	1.0	-0.3	0.
	Baseline Reduced Efficiencies	7124	6860	6954	7064	7512	9424	10181	14585	15769	9300	6052	6245	892
	% Change from Baseline	0.5	0.7	0.8	0.1	0.8	0.3	0.2	0.2	-0.2	-1.1	-0.5	0.2	0.
50%	Baseline Efficiencies	5696	5765	5859	5376	5585	7128	7931	11042	11541	6104	4318	4629	674
	Baseline Increased Efficiencies	5709	5726	5845	5365	5566	7113	7924	11024	11540	6200	4323	4511	673
	% Change from Baseline	0.2	-0.7	-0.2	-0.2	-0.3	-0.2	-0.1	-0.2	-0.0	1.6	0.1	-2.5	-0.
	Baseline Reduced Efficiencies	5801	5829	5829	5385	5615	7111	7917	11072	11479	6014	4241	4611	674
	% Change from Baseline	1.8	1.1	-0.5	0.2	0.5	-0.2	-0.2	0.3	-0.5	-1.5	-1.8	-0.4	-0.
80%	Baseline Efficiencies	4610	4783	4879	3993	4113	4412	5701	7446	7206	3814	3543	3905	486
	Baseline Increased Efficiencies	4600	4727	4849	3986	4106	4384	5702	7450	7234	3892	3576	3882	486
	% Change from Baseline	-0.2	-1.2	-0.6	-0.2	-0.2	-0.6	0.0	0.1	0.4	2.0	0.9	-0.6	-0.
	Baseline Reduced Efficiencies	4623	4855	4929	4003	4128	4447	5720	7421	7161	3746	3498	3896	486
	% Change from Baseline	0.3	1.5	1.0	0.3	0.4	0.8	0.3	-0.3	-0.6	-1.8	-1.3	-0.2	0.

Missouri River Inflows to Fort Peck Reservoir

PERCENTILE FLOW	RUN TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20%	Baseline Efficiencies	8554	8446	7481	8314	10345	15343	14615	19184	22557	13171	8459	8390	12072
	Baseline Increased Efficiencies	8499	8444	7435	8313	10336	15318	14606	19185	22581	13211	8468	8390	12066
	% Change from Baseline	-0.6	-0.0	-0.6	-0.0	-0.1	-0.2	-0.1	0.0	0.1	0.3	0.1	0.0	-0.0
	Baseline Reduced Efficiencies	8648	8451	7554	8312	10696	15360	14627	19185	22573	13020	8439	8389	12104
	% Change from Baseline	1.1	0.1	1.0	-0.0	3.4	0.1	0.1	0.0	0.1	-1.1	-0.2	-0.0	0.3
50%	Baseline Efficiencies	6991	6391	6009	6122	7433	11503	10268	13742	16958	8893	6204	5783	8858
	Baseline Increased Efficiencies	6962	6357	5963	6100	7423	11484	10268	13724	16909	8977	6233	5839	8853
	% Change from Baseline	-0.4	-0.5	-0.8	-0.4	-0.1	-0.2	0.0	-0.1	-0.3	0.9	0.5	1.0	-0.1
	Baseline Reduced Efficiencies	7034	6482	6100	6115	7449	11532	10266	13770	16705	8832	6127	6001	8868
	% Change from Baseline	0.6	1.4	1.5	-0.1	0.2	0.3	-0.0	0.2	-1.5	-0.7	-1.2	3.8	0.1
80%	Baseline Efficiencies	5315	4871	4405	4401	5155	6410	7202	9082	10558	5390	3979	4406	5931
	Baseline Increased Efficiencies	5267	4829	4380	4396	5153	6392	7204	9104	10573	5442	3998	4342	5923
	% Change from Baseline	-0.9	-0.9	-0.6	-0.1	-0.0	-0.3	0.0	0.2	0.1	1.0	0.5	-1.5	-0.1
	Baseline Reduced Efficiencies	5368	4945	4440	4408	5159	6413	7202	9048	10536	5310	3952	4458	5937
	% Change from Baseline	1.0	1.5	0.8	0.2	0.1	0.0	0.0	-0.4	-0.2	-1.5	-0.7	1.2	0.1

Table A-7. Sensitivity of modeled monthly streamflows (cfs) to increased or decreased crop irrigation requirements (CIR)

Jefferson River near Twin Bridges

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
	Baseline CIR	1622	1724	1395	1205	1235	1422	3034	5137	7176	2775	1079	1277	2423
	Baseline CIR X 1.2	1618	1722	1402	1209	1244	1419	3031	5137	7174	2796	1126	1300	2432
20	Percent Change	-0.2	-0.1	0.5	0.3	0.7	-0.2	-0.1	0.0	-0.0	0.8	4.4	1.8	0.4
	Baseline CIR X .8	1632	1723	1394	1201	1227	1428	3036	5138	7271	2725	1098	1253	2427
	Percent Change	0.6	-0.1	-0.1	-0.3	-0.6	0.4	0.1	0.0	1.3	-1.8	1.8	-1.9	0.2
	Baseline CIR	1270	1420	1210	1053	1071	1164	2030	3466	5108	1809	739	931	1773
	Baseline CIR X 1.2	1275	1417	1214	1061	1072	1167	2038	3462	5168	1885	743	948	1787
50	Percent Change	0.4	-0.2	0.3	0.8	0.1	0.3	0.4	-0.1	1.2	4.2	0.5	1.8	0.8
	Baseline CIR X .8	1259	1426	1215	1048	1070	1161	2024	3470	5092	1771	748	927	1768
	Percent Change	-0.9	0.4	0.4	-0.5	-0.1	-0.3	-0.3	0.1	-0.3	-2.1	1.2	-0.4	-0.3
	Baseline CIR	871	1203	1044	904	930	1010	1506	2311	2862	723	201	657	1185
	Baseline CIR X 1.2	864	1197	1038	901	926	1010	1515	2310	2816	695	135	672	1173
80	Percent Change	-0.8	-0.5	-0.6	-0.3	-0.4	0.0	0.6	-0.0	-1.6	-3.9	-32.8	2.3	-1.0
	Baseline CIR X .8	868	1203	1044	901	936	1014	1497	2313	2846	765	283	643	1193
	Percent Change	-0.3	0.0	0.0	-0.3	0.6	0.4	-0.6	0.1	-0.6	5.8	40.8	-2.1	0.7

Canyon Ferry Reservoir Outflows

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20	Baseline CIR	5373	5459	5577	5362	5591	6807	7399	8003	7750	6416	4603	4695	6086
	Baseline CIR X 1.2	5379	5475	5599	5348	5564	6791	7380	7981	7730	6225	4546	4717	6061
	Percent Change	0.1	0.3	0.4	-0.3	-0.5	-0.2	-0.3	-0.3	-0.3	-3.0	-1.2	0.5	-0.4
	Baseline CIR X .8	5367	5421	5554	5380	5615	6829	7422	8030	7775	6622	4665	4695	6115
	Percent Change	-0.1	-0.7	-0.4	0.3	0.4	0.3	0.3	0.3	0.3	3.2	1.3	0.0	0.5
50	Baseline CIR	4831	4830	4835	4080	4172	5289	5777	6276	6067	4357	2928	3026	4706
	Baseline CIR X 1.2	4861	4859	4865	4090	4181	5302	5791	6286	6081	4276	2928	3026	4712
	Percent Change	0.6	0.6	0.6	0.2	0.2	0.2	0.2	0.2	0.2	-1.9	0.0	0.0	0.1
	Baseline CIR X .8	4771	4770	4775	4069	4163	5277	5764	6260	6055	4390	2928	3026	4687
	Percent Change	-1.2	-1.2	-1.2	-0.3	-0.2	-0.2	-0.2	-0.3	-0.2	0.8	0.0	0.0	-0.4
80	Baseline CIR	3901	3900	3905	2928	3242	2928	3142	3373	3287	2928	2928	3026	3291
	Baseline CIR X 1.2	3905	3904	3909	2928	3242	2928	3165	3397	3311	2928	2928	3026	3298
	Percent Change	0.1	0.1	0.1	0.0	0.0	0.0	0.7	0.7	0.7	0.0	0.0	0.0	0.2
	Baseline CIR X .8	3898	3897	3901	2928	3242	2928	3125	3356	3270	2928	2928	3026	3286
	Percent Change	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.5	-0.5	-0.5	0.0	0.0	0.0	-0.2

Missouri River at Fort Benton

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
	Baseline CIR	7089	6814	6898	7055	7455	9398	10156	14562	15793	9405	6080	6235	8912
	Baseline CIR X 1.2	7092	6816	6911	7043	7450	9407	10159	14559	15771	9303	6044	6169	8894
20	Percent Change	0.0	0.0	0.2	-0.2	-0.1	0.1	0.0	-0.0	-0.1	-1.1	-0.6	-1.1	-0.2
	Baseline CIR X .8	7085	6835	6885	7064	7457	9379	10154	14565	15793	9543	6221	6287	8939
	Percent Change	-0.1	0.3	-0.2	0.1	0.0	-0.2	-0.0	0.0	0.0	1.5	2.3	0.8	0.3
	Baseline CIR	5696	5765	5859	5376	5585	7128	7931	11042	11541	6104	4318	4629	6748
	Baseline CIR X 1.2	5711	5775	5868	5380	5592	7125	7932	11046	11504	6041	4204	4392	6714
50	Percent Change	0.3	0.2	0.2	0.1	0.1	-0.0	0.0	0.0	-0.3	-1.0	-2.6	-5.1	-0.5
	Baseline CIR X .8	5682	5744	5799	5359	5580	7084	7902	11040	11565	6281	4353	4828	6768
	Percent Change	-0.2	-0.4	-1.0	-0.3	-0.1	-0.6	-0.4	-0.0	0.2	2.9	0.8	4.3	0.3
	Baseline CIR	4610	4783	4879	3993	4113	4412	5701	7446	7206	3814	3543	3905	4867
	Baseline CIR X 1.2	4601	4778	4879	3997	4117	4429	5708	7413	7148	3740	3476	3878	4847
80	Percent Change	-0.2	-0.1	0.0	0.1	0.1	0.4	0.1	-0.4	-0.8	-1.9	-1.9	-0.7	-0.4
	Baseline CIR X .8	4615	4767	4879	3988	4109	4384	5694	7472	7264	3930	3626	3933	4888
	Percent Change	0.1	-0.3	0.0	-0.1	-0.1	-0.6	-0.1	0.3	0.8	3.0	2.3	0.7	0.4

Missouri River inflows to Fort Peck Reservoir

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20	Baseline CIR	8554	8446	7481	8314	10345	15343	14615	19184	22557	13171	8459	8390	12072
	Baseline CIR X 1.2	8568	8439	7505	8309	10343	15325	14627	19175	22565	13053	8344	8363	12052
	Percent Change	0.2	-0.1	0.3	-0.1	-0.0	-0.1	0.1	-0.0	0.0	-0.9	-1.4	-0.3	-0.2
	Baseline CIR X .8	8540	8453	7464	8317	10346	15347	14603	19194	22633	13225	8574	8389	12090
	Percent Change	-0.2	0.1	-0.2	0.0	0.0	0.0	-0.1	0.1	0.3	0.4	1.4	-0.0	0.1
50	Baseline CIR	6991	6391	6009	6122	7433	11503	10268	13742	16958	8893	6204	5783	8858
	Baseline CIR X 1.2	7014	6424	6030	6125	7432	11506	10268	13740	16910	8895	6059	5887	8858
	Percent Change	0.3	0.5	0.3	0.0	-0.0	0.0	0.0	-0.0	-0.3	0.0	-2.3	1.8	0.0
	Baseline CIR X .8	6866	6356	5998	6073	7428	11500	10267	13760	16922	9027	6289	6052	8878
	Percent Change	-1.8	-0.5	-0.2	-0.8	-0.1	-0.0	-0.0	0.1	-0.2	1.5	1.4	4.7	0.2
80	Baseline CIR	5315	4871	4405	4401	5155	6410	7202	9082	10558	5390	3979	4406	5931
	Baseline CIR X 1.2	5291	4888	4375	4403	5155	6424	7195	9046	10477	5276	3901	4363	5899
	Percent Change	-0.5	0.3	-0.7	0.0	0.0	0.2	-0.1	-0.4	-0.8	-2.1	-2.0	-1.0	-0.5
	Baseline CIR X .8	5323	4855	4429	4399	5156	6396	7212	9119	10640	5525	4072	4399	5960
	Percent Change	0.2	-0.3	0.5	-0.0	0.0	-0.2	0.1	0.4	0.8	2.5	2.3	-0.2	0.5

Table A-8. Sensitivity of modeled monthly streamflows (cfs) to increased or decreased groundwater return flow factors (GRFF)

Jefferson River near Twin Bridges

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AV
20	Baseline GRFF	1622	1724	1395	1205	1235	1422	3034	5137	7176	2775	1079	1277	242
	Baseline GRFF X 10	1649	1728	1419	1193	1197	1443	3025	5138	7299	2701	1105	1264	243
	Percent Change	1.7	0.2	1.7	-1.0	-3.1	1.5	-0.3	0.0	1.7	-2.7	2.4	-1.0	0.
	Baseline GRFF X .1	1620	1698	1395	1220	1260	1408	3013	5128	7172	2775	1165	1333	243
	Percent Change	-0.1	-1.5	0.0	1.2	2.0	-1.0	-0.7	-0.2	-0.1	0.0	8.0	4.4	0.
50	Baseline GRFF	1270	1420	1210	1053	1071	1164	2030	3466	5108	1809	739	931	177
	Baseline GRFF X 10	1264	1459	1206	1040	1078	1170	2007	3471	5078	1758	761	941	177
	Percent Change	-0.5	2.7	-0.3	-1.2	0.7	0.5	-1.1	0.1	-0.6	-2.8	3.0	1.1	-0.
	Baseline GRFF X .1	1264	1391	1191	1047	1071	1159	2056	3439	5139	1885	802	986	178
	Percent Change	-0.5	-2.0	-1.6	-0.6	0.0	-0.4	1.3	-0.8	0.6	4.2	8.5	5.9	0.
80	Baseline GRFF	871	1203	1044	904	930	1010	1506	2311	2862	723	201	657	118
	Baseline GRFF X 10	885	1198	1026	891	919	1014	1460	2299	2839	748	311	661	118
	Percent Change	1.6	-0.4	-1.7	-1.4	-1.2	0.4	-3.1	-0.5	-0.8	3.5	54.7	0.6	0.
	Baseline GRFF X .1	855	1175	1032	883	910	1001	1539	2318	2857	760	202	662	118
	Percent Change	-1.8	-2.3	-1.1	-2.3	-2.2	-0.9	2.2	0.3	-0.2	5.1	0.5	0.8	-0.

Canyon Ferry Reservoir Outflows

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20	Baseline GRFF	5373	5459	5577	5362	5591	6807	7399	8003	7750	6416	4603	4695	6086
	Baseline GRFF X 10	5342	5412	5508	5356	5535	6799	7391	7997	7743	6585	4712	4735	6093
	Percent Change	-0.6	-0.9	-1.2	-0.1	-1.0	-0.1	-0.1	-0.1	-0.1	2.6	2.4	0.9	0.1
	Baseline GRFF X .1	5372	5469	5584	5351	5587	6794	7384	7987	7735	6367	4680	4785	6091
	Percent Change	-0.0	0.2	0.1	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2	-0.8	1.7	1.9	0.1
50	Baseline GRFF	4831	4830	4835	4080	4172	5289	5777	6276	6067	4357	2928	3026	4706
	Baseline GRFF X 10	4721	4720	4725	4048	4107	5256	5740	6214	6025	4352	2928	3126	4663
	Percent Change	-2.3	-2.3	-2.3	-0.8	-1.6	-0.6	-0.6	-1.0	-0.7	-0.1	0.0	3.3	-0.9
	Baseline GRFF X .1	4819	4817	4823	4071	4182	5278	5765	6270	6057	4398	2928	3026	4703
	Percent Change	-0.2	-0.3	-0.2	-0.2	0.2	-0.2	-0.2	-0.1	-0.2	0.9	0.0	0.0	-0.1
80	Baseline GRFF	3901	3900	3905	2928	3242	2928	3142	3373	3287	2928	2928	3026	3291
	Baseline GRFF X 10	3908	3907	3911	2928	3242	2928	3130	3359	3274	2928	2928	3026	3289
	Percent Change	0.2	0.2	0.2	0.0	0.0	0.0	-0.4	-0.4	-0.4	0.0	0.0	0.0	-0.1
	Baseline GRFF X .1	3943	3942	3946	2928	3242	2928	3086	3315	3230	2928	2928	3026	3287
	Percent Change	1.1	1.1	1.0	0.0	0.0	0.0	-1.8	-1.7	-1.7	0.0	0.0	0.0	-0.1

Missouri River at Fort Benton

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
20	Baseline GRFF	7089	6814	6898	7055	7455	9398	10156	14562	15793	9405	6080	6235	8912
	Baseline GRFF X 10	7075	6806	6829	7042	7431	9348	10119	14511	15810	9499	6231	6316	8918
	Percent Change	-0.2	-0.1	-1.0	-0.2	-0.3	-0.5	-0.4	-0.4	0.1	1.0	2.5	1.3	0.1
	Baseline GRFF X .1	7149	6890	6937	7065	7446	9394	10163	14588	15712	9357	6060	6360	8927
	Percent Change	0.8	1.1	0.6	0.1	-0.1	-0.0	0.1	0.2	-0.5	-0.5	-0.3	2.0	0.2
50	Baseline GRFF	5696	5765	5859	5376	5585	7128	7931	11042	11541	6104	4318	4629	6748
	Baseline GRFF X 10	5604	5719	5757	5315	5551	7041	7876	11026	11473	6281	4304	4812	6730
	Percent Change	-1.6	-0.8	-1.7	-1.1	-0.6	-1.2	-0.7	-0.1	-0.6	2.9	-0.3	4.0	-0.3
	Baseline GRFF X .1	5763	5766	5849	5416	5604	7153	7912	11041	11358	6131	4188	4611	6733
	Percent Change	1.2	0.0	-0.2	0.7	0.3	0.4	-0.2	-0.0	-1.6	0.4	-3.0	-0.4	-0.2
80	Baseline GRFF	4610	4783	4879	3993	4113	4412	5701	7446	7206	3814	3543	3905	4867
	Baseline GRFF X 10	4619	4785	4894	3971	4093	4366	5601	7383	7232	3905	3573	3914	4861
	Percent Change	0.2	0.0	0.3	-0.6	-0.5	-1.0	-1.8	-0.8	0.4	2.4	0.8	0.2	-0.1
	Baseline GRFF X .1	4637	4944	4902	4060	4159	4422	5696	7422	7130	3712	3469	3885	4870
	Percent Change	0.6	3.4	0.5	1.7	1.1	0.2	-0.1	-0.3	-1.1	-2.7	-2.1	-0.5	0.1

Missouri River inflows to Fort Peck Reservoir

PERCENTILE FLOW	CROP REQUIREMENTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
	Baseline GRFF	8554	8446	7481	8314	10345	15343	14615	19184	22557	13171	8459	8390	12072
	Baseline GRFF X 10	8524	8443	7401	8321	10342	15255	14587	19177	22579	13176	8588	8446	12070
20	Percent Change	-0.4	-0.0	-1.1	0.1	-0.0	-0.6	-0.2	-0.0	0.1	0.0	1.5	0.7	-0.0
	Baseline GRFF X .1	8672	8460	7561	8266	10407	15388	14640	19177	22527	13180	8430	8458	12097
	Percent Change	1.4	0.2	1.1	-0.6	0.6	0.3	0.2	-0.0	-0.1	0.1	-0.3	0.8	0.2
	Baseline GRFF	6991	6391	6009	6122	7433	11503	10268	13742	16958	8893	6204	5783	8858
	Baseline GRFF X 10	6821	6305	6013	6042	7415	11484	10285	13733	16800	8875	6185	6086	8837
50	Percent Change	-2.4	-1.3	0.1	-1.3	-0.2	-0.2	0.2	-0.1	-0.9	-0.2	-0.3	5.2	-0.2
	Baseline GRFF X .1	6983	6471	6071	6206	7466	11491	10230	13721	16771	8950	5962	5990	8859
	Percent Change	-0.1	1.3	1.0	1.4	0.4	-0.1	-0.4	-0.2	-1.1	0.6	-3.9	3.6	0.0
	Baseline GRFF	5315	4871	4405	4401	5155	6410	7202	9082	10558	5390	3979	4406	5931
	Baseline GRFF X 10	5270	4821	4388	4374	5153	6350	7192	9049	10601	5408	3979	4414	5917
80	Percent Change	-0.8	-1.0	-0.4	-0.6	-0.0	-0.9	-0.1	-0.4	0.4	0.3	0.0	0.2	-0.2
	Baseline GRFF X .1	5348	4958	4469	4379	5173	6493	7221	9100	10468	5277	3951	4394	5936
	Percent Change	0.6	1.8	1.5	-0.5	0.3	1.3	0.3	0.2	-0.9	-2.1	-0.7	-0.3	0.1

APPENDIX B

COMPARISON OF WATER VALUES FOR CONSUMPTIVE USE AND INSTREAM USE

Table B-1 (Revised Table K-4). Comparison of water vaues for consumptive use and instream use ($/AcFt)[a]

DRAINAGE/ Application				50 Mill (5 Cents) Per Kilowatt Hour Replacement Cost[b]							100 Mill (10 Cents) Per Kilowatt Hour Replacement Cost[c]						
	Consumptive Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value		
	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]		
	#1	#2	#3	#1	#2	#3		#1	#2	#3	#1	#2	#3		#1	#2	#3
HEADWATERS SUBBASIN																	
GALLATIN RIVER																	
Bozeman	586.70			583.45			71.67	511.77			567.15			130.59	495.47		
Belgrade	586.70			583.45			71.67	511.77			567.15			130.59	495.47		
GA-79	85.00	47.60	58.62	82.78	45.38	55.56	80.73	2.05	-35.35	-25.17	71.67	34.27	40.24	139.64	-67.97	-105.38	-99.40
GA-35	57.75	40.71	56.95	55.36	38.32	52.24	80.73	-25.37	-42.41	-28.49	43.42	26.38	28.68	139.64	-96.23	-113.27	-110.96
GA-46	131.15	85.11	53.31	129.55	83.51	52.02	80.73	48.82	2.78	-28.71	121.57	75.53	45.53	139.64	-18.07	-64.11	-94.12
GA-124	113.78	73.83	49.01	111.64	71.70	47.17	80.73	30.91	-9.03	-33.56	100.95	61.01	37.96	139.64	-38.69	-78.64	-101.68
GA-44	109.79	71.25	45.75	107.51	68.97	43.85	80.73	26.78	-11.76	-36.88	96.12	57.57	34.35	139.64	-43.53	-82.07	-105.29
GA-13	109.26	71.61	44.54	106.62	68.98	42.40	80.73	25.89	-11.75	-38.33	93.45	55.81	31.66	139.64	-46.19	-83.84	-107.99
GA-81	60.75	34.02	42.01	59.30	32.57	40.00	80.73	-21.43	-48.16	-40.73	52.05	25.32	29.98	139.64	-87.59	-114.32	-109.66
GA-24	80.95	52.53	33.96	78.76	50.34	32.13	80.73	-1.97	-30.39	-48.60	67.83	39.42	22.96	139.64	-71.81	-100.23	-116.69
GA-92	44.71	25.04	31.67	41.94	22.26	27.74	80.73	-38.79	-58.47	-52.99	28.08	8.41	8.11	139.64	-111.57	-131.24	-131.53
GA-14	72.50	47.52	31.25	70.11	45.13	29.19	80.73	-10.62	-35.60	-51.54	58.14	33.16	18.87	139.64	-81.50	-106.49	-120.78
GA-151	95.88	53.69	27.97	87.80	45.61	23.25	80.73	7.07	-35.12	-57.48	47.42	5.23	-0.30	139.64	-92.22	-134.41	-139.95
GA-41	66.30	43.02	26.95	63.51	40.23	24.68	80.73	-17.22	-40.50	-56.05	49.55	26.27	13.33	139.64	-90.10	-113.37	-126.31
GA-143	39.91	31.92	25.63	37.17	29.18	22.11	80.73	-43.56	-51.55	-58.62	23.46	15.47	4.50	139.64	-116.19	-124.18	-135.14
GA-40	55.77	36.19	24.04	52.58	33.00	21.29	80.73	-28.15	-47.73	-59.44	36.63	17.05	7.54	139.64	-103.02	-122.60	-132.11
GA-130	25.99	17.04	18.12	24.09	15.14	15.47	80.73	-56.64	-65.59	-65.26	14.59	5.63	2.22	139.64	-125.05	-134.01	-137.42
GA-110	20.12	13.18	14.21	18.52	11.59	11.95	80.73	-62.21	-69.14	-68.78	10.53	3.60	0.66	139.64	-129.12	-136.05	-138.98
MADISON RIVER																	
West Yellowstone	586.70			583.45			71.67	511.77			567.15			130.59	436.56		
GA-201	398.49	199.24	168.22	385.50	186.25	157.25	80.73	304.77	105.52	76.52	320.55	121.30	102.41	139.64	180.90	-18.34	-37.23
JEFFERSON RIVER																	
Three Forks	586.70			583.45			71.67	511.77			567.15			130.59	436.56		
JV-95	49.42	47.70	65.60	48.62	46.90	63.46	80.73	-32.11	-33.83	-17.27	44.59	42.87	52.77	139.64	-95.05	-96.78	-86.87
GA-102	61.49	38.75	59.12	60.20	37.46	56.65	80.73	-20.53	-43.27	-24.08	53.78	31.04	44.31	139.64	-85.86	-108.60	-95.34
JV-81	88.86	55.99	57.43	85.03	52.16	52.48	80.73	4.30	-28.57	-28.25	65.87	33.01	27.72	139.64	-73.77	-106.64	-111.93
JV-25	98.39	55.10	57.30	96.49	53.19	55.08	80.73	15.76	-27.54	-25.65	86.97	43.67	43.99	139.64	-52.68	-95.97	-95.65
JV-204	73.85	48.89	55.14	72.53	47.58	53.18	80.73	-8.20	-33.15	-27.55	65.95	41.00	43.35	139.64	-73.69	-98.65	-96.29
JV-63	79.01	49.79	54.54	76.56	47.34	51.15	80.73	-4.17	-33.39	-29.58	64.30	35.08	34.24	139.64	-75.34	-104.56	-105.41
JV-202	85.42	42.71	48.05	81.95	39.25	44.16	80.73	1.23	-41.48	-36.57	64.63	21.92	24.67	139.64	-75.01	-117.72	-114.98
JV-17	114.82	94.13	46.65	113.74	93.06	45.78	80.73	33.01	12.33	-34.95	108.38	87.70	41.42	139.64	-31.27	-51.95	-98.23
JV-18	108.19	88.70	43.73	107.27	87.79	43.00	80.73	26.54	7.06	-37.73	102.72	83.23	39.31	139.64	-36.93	-56.42	-100.33
JV-80	90.89	74.52	42.10	89.84	73.47	41.13	80.73	9.11	-7.26	-39.60	84.59	68.22	36.26	139.64	-55.06	-71.43	-103.38
BR-52	50.68	31.93	34.95	47.63	28.89	30.75	80.73	-33.10	-51.84	-49.98	32.41	13.66	9.75	139.64	-107.24	-125.98	-129.90
JV-55	62.14	42.43	32.46	59.47	39.76	29.67	80.73	-21.26	-40.97	-51.06	46.11	26.40	15.71	139.64	-93.53	-113.24	-123.93
JV-201	50.10	25.05	30.20	47.29	22.24	26.80	80.73	-33.44	-58.49	-53.93	33.22	8.17	9.85	139.64	-106.42	-131.47	-129.80
JV-203	43.42	21.71	28.25	40.99	19.28	25.09	80.73	-39.74	-61.45	-55.64	28.83	7.12	9.27	139.64	-110.81	-132.52	-130.38
BR-101	28.05	14.03	22.38	24.32	10.30	16.43	80.73	-56.41	-70.43	-64.30	5.68	-8.34	-13.31	139.64	-133.96	-147.99	-152.95
BEAVERHEAD RIVER																	
Dillon	586.70			583.45			71.67	511.77			567.15			130.59	436.56		

Table B-1 (continued)

				50 Mill (5 Cents) Per Kilowatt Hour Replacement Cost[b]							100 Mill (10 Cents) Per Kilowatt Hour Replacement Cost[c]						
	Consumptive Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value		
DRAINAGE/ Application	Method[e] #1	#2	#3	Method[e] #1	#2	#3	(Hydropower & Recreation)	Method[e] #1	#2	#3	Method[e] #1	#2	#3	(Hydropower & Recreation)	Method[e] #1	#2	#3
UPPER MISSOURI SUBBASIN																	
MISSOURI RIVER-THREE FORKS TO HOLTER DAM																	
Helena	586.70			583.45			57.19	526.26			567.15			107.17	459.98		
East Helena	586.70			583.45			57.19	526.26			567.15			107.17	459.98		
BR-38	92.51	70.53	57.95	90.50	68.53	55.44	68.99	21.51	-0.46	-13.55	80.50	58.53	42.91	125.87	-45.37	-67.34	-82.97
BR-34	68.38	43.09	37.26	66.37	41.08	35.08	68.99	-2.62	-27.91	-33.92	56.34	31.06	24.15	125.87	-69.53	-94.82	-101.73
BR-50	50.39	31.75	30.03	47.32	28.69	26.38	71.02	-23.70	-42.34	-44.65	31.99	13.36	8.11	129.94	-97.95	-116.58	-121.83
BR-42	59.26	45.18	27.58	57.05	42.97	25.53	68.99	-11.94	-26.02	-43.46	46.00	31.93	15.25	125.87	-79.87	-93.94	-110.63
BR-103	51.16	25.58	26.80	49.68	24.09	25.24	68.99	-19.31	-44.90	-43.75	42.24	16.66	17.45	125.87	-83.63	-109.22	-108.42
LC-11	25.23	17.41	19.79	23.43	15.61	16.97	62.09	-38.65	-46.48	-45.12	14.43	6.61	2.85	112.07	-97.63	-105.45	-109.22
LCI-10	29.80	14.90	16.50	25.80	10.90	12.08	62.09	-36.28	-51.18	-50.01	5.84	-9.06	-10.04	112.07	-106.23	-121.13	-122.11
BR-41	65.51	32.76	18.17	61.39	28.63	15.89	68.99	-7.60	-40.36	-53.11	40.77	8.01	4.45	125.87	-85.11	-117.86	-121.43
BR-11	53.74	26.87	17.67	49.14	22.26	14.64	68.99	-19.86	-46.73	-54.35	26.10	-0.77	-0.51	125.87	-99.77	-126.64	-126.38
BR-40	62.60	31.30	17.00	58.81	27.51	14.94	68.99	-10.18	-41.48	-54.05	39.89	8.59	4.66	125.87	-85.99	-117.29	-121.21
BR-108	50.21	25.10	16.52	47.55	22.44	14.77	68.99	-21.44	-46.55	-54.22	34.25	9.15	6.02	125.87	-91.62	-116.73	-119.85
BR-35	29.25	18.43	15.94	25.50	14.69	11.86	68.99	-43.49	-54.30	-57.13	6.79	-4.03	-8.54	125.87	-119.09	-129.90	-134.41
BR-106	45.17	22.58	14.95	41.56	18.98	12.57	68.99	-27.43	-50.01	-56.42	23.54	0.96	0.64	125.87	-102.33	-124.91	-125.24
BR-28	40.66	20.33	13.46	36.93	16.60	10.99	68.99	-32.07	-52.40	-58.00	18.25	-2.08	-1.38	125.87	-107.63	-127.96	-127.25
BR-107	39.11	19.56	12.94	35.61	16.05	10.63	68.99	-33.38	-52.94	-58.37	18.09	-1.46	-0.97	125.87	-107.78	-127.34	-126.84
BR-44	36.35	18.17	12.00	31.54	13.36	8.83	68.99	-37.45	-55.63	-60.17	7.48	-10.69	-7.06	125.87	-118.39	-136.56	-132.93
BR-14	35.87	17.94	11.85	30.97	13.04	8.61	68.99	-38.02	-55.95	-60.38	6.48	-11.46	-7.57	125.87	-119.39	-137.33	-133.44
BR-110	35.40	17.70	11.66	30.83	13.13	8.65	68.99	-38.16	-55.86	-60.34	8.01	-9.69	-6.38	125.87	-117.86	-135.56	-132.26
BR-5	35.03	17.52	11.53	30.83	13.31	8.76	68.99	-38.16	-55.68	-60.23	9.80	-7.72	-5.08	125.87	-116.08	-133.59	-130.96
BR-29	13.46	10.63	9.74	10.56	7.73	5.54	68.99	-58.44	-61.26	-63.45	-3.94	-6.77	-15.46	125.87	-129.82	-132.64	-141.33
BR-12	26.60	13.30	8.43	21.91	8.61	5.46	68.99	-47.08	-60.38	-63.53	-1.51	-14.81	-9.39	125.87	-127.39	-140.69	-135.27
BR-109	20.32	10.16	6.70	15.60	5.44	3.59	68.99	-53.40	-63.55	-65.40	-8.01	-18.17	-11.99	125.87	-133.88	-144.04	-137.86
BR-111	8.83	4.42	2.87	4.26	-0.15	-0.10	68.99	-64.73	-69.14	-69.09	-18.57	-22.99	-14.95	125.87	-144.45	-148.86	-140.83
BR-104	-27.39	-13.69	-17.77	-30.84	-17.15	-22.25	68.99	-99.83	-86.14	-91.24	-48.11	-34.41	-44.66	125.87	-173.98	-160.29	-170.53
MISSOURI RIVER-HOLTER DAM TO BELT CREEK																	
Great Falls	586.70			583.45			53.23	530.21			567.15			99.26	467.89		
CSI-52	73.37	45.36	57.19	72.00	43.99	55.05	58.13	13.86	-14.15	-3.08	65.12	37.11	44.33	104.16	-39.04	-67.05	-59.83
CS-101	79.74	49.30	54.11	78.44	48.00	52.34	58.13	20.30	-10.14	-5.79	71.94	41.49	43.52	104.16	-32.22	-62.67	-60.64
CSI-103	68.14	42.13	52.42	66.51	40.50	49.92	58.13	8.38	-17.64	-8.22	58.36	32.35	37.38	104.16	-45.80	-71.81	-66.78
CSI-51	55.90	38.17	50.63	53.42	35.69	46.14	58.13	-4.72	-22.45	-11.99	41.02	23.30	23.69	104.16	-63.13	-80.86	-80.47
CSI-101	75.63	46.76	50.50	74.32	45.44	48.74	58.13	16.18	-12.69	-9.39	67.74	38.86	39.95	104.16	-36.42	-65.30	-64.21
CS-111	66.27	40.97	45.73	63.88	38.58	42.42	58.13	5.74	-19.56	-15.72	51.89	26.59	25.88	104.16	-52.27	-77.57	-78.28
CS-102	55.75	38.07	42.16	53.88	36.19	39.32	58.13	-4.26	-21.94	-18.62	44.50	26.81	25.13	104.16	-59.66	-77.35	-79.03
CS-541	61.88	38.26	41.86	59.89	36.27	39.17	58.13	1.76	-21.87	-18.96	49.95	26.32	25.72	104.16	-54.21	-77.83	-78.44
CSI-11	52.37	36.14	41.52	50.19	33.96	38.06	58.13	-7.95	-24.18	-20.07	39.28	23.05	20.76	104.16	-64.88	-81.11	-83.40
CSI-22	53.24	36.35	39.81	50.97	34.08	36.41	58.13	-7.17	-24.05	-21.72	39.62	22.73	19.44	104.16	-64.54	-81.43	-84.72
CSI-41	37.70	26.01	39.00	35.51	23.82	34.47	58.13	-22.63	-34.31	-23.67	24.56	12.88	11.82	104.16	-79.60	-91.28	-92.34

Table B-1 (continued)

				50 Mill (5 Cents) Per Kilowatt Hour Replacement Cost[b]							100 Mill (10 Cents) Per Kilowatt Hour Replacement Cost[c]						
	Consumptive Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value		
	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]		
DRAINAGE/ Application	#1	#2	#3	#1	#2	#3		#1	#2	#3	#1	#2	#3		#1	#2	#3
CS-351	51.64	33.18	36.51	49.56	31.10	33.56	58.13	-8.57	-27.03	-24.57	39.15	20.69	18.84	104.16	-65.01	-83.47	-85.32
CSI-21	46.94	32.05	36.49	44.61	29.72	32.85	58.13	-13.53	-28.42	-25.28	32.91	18.02	14.67	104.16	-71.25	-86.14	-89.49
CSI-35	44.55	27.54	33.74	43.26	26.26	31.80	58.13	-14.87	-31.88	-26.34	36.85	19.84	22.08	104.16	-67.31	-84.32	-82.08
CSI-12	37.24	25.69	28.44	35.34	23.80	25.55	58.13	-22.80	-34.34	-32.59	25.85	14.31	11.05	104.16	-78.31	-89.85	-93.11
CSI-31	36.67	22.67	27.76	35.02	21.02	25.25	58.13	-23.12	-37.12	-32.88	26.75	12.75	12.73	104.16	-77.41	-91.41	-91.43
CSI-23	35.16	24.01	26.93	32.81	21.66	23.34	58.13	-25.32	-36.47	-34.80	21.10	9.95	5.39	104.16	-83.06	-94.21	-98.77
CSI-34	30.04	20.73	26.21	28.06	18.75	22.75	58.13	-30.07	-39.39	-35.38	18.16	8.85	5.49	104.16	-85.99	-95.31	-98.67
CSI-33	21.51	14.84	17.16	18.90	12.23	13.00	58.13	-39.24	-45.90	-45.14	5.84	-0.83	-7.84	104.16	-98.32	-104.99	-112.00
CSI-32	15.67	10.70	11.62	12.24	7.27	6.53	58.13	-45.90	-50.86	-51.60	-4.90	-9.87	-18.89	104.16	-109.06	-114.03	-123.05
LC-210	41.55	28.37	32.71	39.46	26.28	29.42	58.13	-18.68	-31.85	-28.72	29.02	15.84	12.99	104.16	-75.14	-88.32	-91.17
DEARBORN RIVER																	
LCI-20	52.06	32.18	35.40	52.06	32.18	35.40	58.13	-6.08	-25.95	-22.73	52.06	32.18	35.40	104.16	-52.10	-71.98	-68.76
SMITH RIVER																	
CS-271	53.06	35.86	49.38	50.83	33.63	45.23	58.13	-7.30	-24.51	-12.91	39.68	22.48	24.47	104.16	-64.48	-81.68	-79.69
CS-61	70.53	43.60	46.73	69.43	42.51	45.28	58.13	11.30	-15.63	-12.86	63.94	37.02	38.00	104.16	-40.22	-67.14	-66.15
CSI-102	56.58	38.63	44.38	54.54	36.59	41.18	58.13	-3.60	-21.54	-16.96	44.33	26.39	25.17	104.16	-59.83	-77.77	-78.99
CS-252	42.35	29.23	37.92	40.28	27.16	34.21	58.13	-17.85	-30.98	-23.92	29.93	16.80	15.67	104.16	-74.23	-87.36	-88.48
CS-62	42.04	28.71	34.07	40.25	26.92	31.17	58.13	-17.88	-31.22	-26.97	31.31	17.97	16.67	104.16	-72.85	-86.19	-87.49
CS-63	32.74	26.51	32.49	32.20	25.97	31.42	58.13	-25.93	-32.16	-26.72	29.50	23.27	26.05	104.16	-74.66	-80.89	-78.11
CSI-111	44.55	28.63	31.61	42.21	26.29	28.30	58.13	-15.92	-31.85	-29.84	30.53	14.60	11.71	104.16	-73.63	-89.56	-92.45
CS-331	38.35	26.19	30.36	36.36	24.20	27.21	58.13	-21.77	-33.94	-30.92	26.42	14.25	11.46	104.16	-77.74	-89.91	-92.70
CS-64	33.56	22.92	25.82	31.40	20.75	22.49	58.13	-26.73	-37.38	-35.64	20.58	9.94	5.85	104.16	-83.58	-94.22	-98.31
CS-251	35.87	17.93	25.25	32.76	14.82	20.87	58.13	-25.38	-43.31	-37.26	17.20	-0.74	-1.04	104.16	-86.96	-104.90	-105.20
CS-71	24.80	17.48	23.68	21.48	14.16	17.34	58.13	-36.65	-43.97	-40.80	4.87	-2.44	-14.37	104.16	-99.28	-106.60	-118.53
CSI-120	20.78	14.65	15.88	18.47	12.34	12.35	58.13	-39.67	-45.80	-45.78	6.91	0.78	-5.32	104.16	-97.25	-103.38	-109.48
MEI-12	33.48	23.60	17.34	30.96	21.08	14.72	58.13	-27.18	-37.06	-43.41	18.32	8.45	1.64	104.16	-85.83	-95.71	-102.52
MEI-20	19.30	9.65	7.92	16.13	6.47	5.32	58.13	-42.01	-51.66	-52.82	0.25	-9.40	-7.72	104.16	-103.91	-113.56	-111.88
MEI-11	18.48	9.24	7.77	15.59	6.35	5.34	58.13	-42.54	-51.79	-52.80	1.13	-8.11	-6.81	104.16	-103.03	-112.27	-110.97
SUN RIVER																	
Great Falls	586.70			583.45			53.23	530.21			567.15			99.26	467.89		
Power	586.70			583.45			53.23	530.21			567.15			99.26	467.89		
Fairfield	586.70			583.45			53.23	530.21			567.15			99.26	467.89		
CSI-83	46.67	32.20	53.72	45.01	30.55	49.91	58.13	-13.12	-27.59	-8.23	36.73	22.27	30.85	104.16	-67.43	-81.89	-73.31
CS-241	39.39	26.90	43.02	37.20	24.71	38.23	58.13	-20.93	-33.43	-19.91	26.23	13.74	14.27	104.16	-77.93	-90.42	-89.89
CSI-81	32.13	22.17	35.86	29.97	20.01	31.04	58.13	-28.17	-38.13	-27.10	19.15	9.19	6.90	104.16	-85.01	-94.97	-97.26
CSI-92	26.98	18.82	33.50	25.54	17.38	29.92	58.13	-32.59	-40.76	-28.21	18.35	10.18	12.06	104.16	-85.81	-93.98	-92.10
CSI-91	29.90	20.63	33.25	28.05	18.78	29.14	58.13	-30.08	-39.35	-28.99	18.82	9.55	8.60	104.16	-85.34	-94.61	-95.56
CSI-82	31.37	21.42	33.06	29.61	19.66	29.36	58.13	-28.52	-38.47	-28.78	20.83	10.89	10.86	104.16	-83.33	-93.27	-93.30
CSI-71	29.87	20.39	31.46	26.59	17.11	24.55	58.13	-31.55	-41.02	-33.59	10.18	0.71	-10.00	104.16	-93.97	-103.45	-114.16
CS-171	27.77	18.96	27.00	25.61	16.80	22.80	58.13	-32.52	-41.33	-35.33	14.82	6.02	1.83	104.16	-89.34	-98.14	-102.33
CS-471	23.22	16.03	25.23	20.18	12.98	18.61	58.13	-37.95	-45.15	-39.52	4.96	-2.24	-14.46	104.16	-99.20	-106.40	-118.62

Table B-1 (continued)

				50 Mill (5 Cents) Per Kilowatt Hour Replacement Cost[b]							100 Mill (10 Cents) Per Kilowatt Hour Replacement Cost[c]						
	Consumptive Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value		
DRAINAGE/ Application	Method[e] #1	#2	#3	Method[e] #1	#2	#3	(Hydropower & Recreation)	Method[e] #1	#2	#3	Method[e] #1	#2	#3	(Hydropower & Recreation)	Method[e] #1	#2	#3
CS-52	24.01	16.39	25.13	21.52	13.90	19.91	58.13	-36.62	-44.23	-38.22	9.07	1.45	-6.14	104.16	-95.09	-102.71	-110.30
CS-31	15.66	10.69	17.12	13.71	8.75	12.86	58.13	-44.42	-49.39	-45.28	3.97	-1.00	-8.43	104.16	-100.19	-105.15	-112.59
TEI-100	38.42	23.53	51.12	38.42	23.53	51.12	58.13	-19.72	-34.61	-7.01	38.42	23.53	51.12	104.16	-65.74	-80.63	-53.04
TEI-80	52.90	32.71	50.87	52.90	32.71	50.87	58.13	-5.23	-25.43	-7.27	52.90	32.71	50.87	104.16	-51.26	-71.45	-53.29
CS-32	9.12	6.22	9.22	7.06	4.17	5.06	58.13	-51.07	-53.97	-53.07	-3.22	-6.11	-15.73	104.16	-107.38	-110.27	-119.89
CS-51	7.55	5.21	8.36	5.62	3.27	4.07	58.13	-52.52	-54.86	-54.07	-4.07	-6.41	-17.36	104.16	-108.23	-110.57	-121.52
CS-231	5.95	4.20	5.53	4.00	2.25	1.91	58.13	-54.13	-55.89	-56.23	-5.75	-7.50	-16.20	104.16	-109.91	-111.66	-120.36
TE-181	46.63	28.83	41.98	44.13	26.33	37.49	58.13	-14.00	-31.80	-20.64	31.66	13.86	15.04	104.16	-72.50	-90.30	-89.12
TEI-90	33.93	16.97	39.59	33.93	16.97	39.59	58.13	-24.20	-41.17	-18.55	33.93	16.97	39.59	104.16	-70.23	-87.19	-64.57
CS-21	1.42	0.97	1.53	1.42	0.97	1.53	58.13	-56.71	-57.16	-56.60	1.42	0.97	1.53	104.16	-102.74	-103.19	-102.63
LC-131	32.62	16.31	26.20	30.60	14.29	22.95	58.13	-27.53	-43.85	-35.18	20.49	4.18	6.71	104.16	-83.67	-99.98	-97.45
TE-183	34.70	17.35	24.20	30.68	13.33	18.59	58.13	-27.46	-44.81	-39.55	10.55	-6.80	-9.49	104.16	-93.61	-110.96	-113.65
TE-571	40.78	20.39	23.25	38.23	17.84	20.35	58.13	-19.90	-40.29	-37.79	25.52	5.13	5.85	104.16	-78.64	-99.03	-98.31
LC-251	6.00	3.00	0.60	4.06	1.06	0.21	58.13	-54.07	-57.07	-57.92	-5.61	-8.61	-1.72	104.16	-109.77	-112.77	-105.88
CSS-200	-0.42	-0.21	-0.33	-7.95	-7.75	-12.39	58.13	-66.09	-65.88	-70.53	-45.64	-45.43	-72.69	104.16	-149.80	-149.59	-176.85
BELT RIVER																	
CS-43	64.21	39.70	54.17	61.59	37.07	49.74	45.47	16.12	-8.40	4.27	48.47	23.96	27.61	78.83	-30.36	-54.88	-51.22
CS-42	38.71	31.74	49.28	38.16	31.19	47.89	45.47	-7.31	-14.28	2.42	35.43	28.46	40.93	78.83	-43.40	-50.37	-37.90
JB-281	45.35	37.65	45.35	45.35	37.65	45.35	45.47	-0.12	-7.82	-0.12	45.35	37.65	45.35	78.83	-33.49	-41.18	-33.49
CS-44	43.90	27.40	35.72	43.90	27.40	35.72	45.47	-1.57	-18.07	-9.75	43.90	27.40	35.72	78.83	-34.93	-51.43	-43.11
JB-61	46.56	28.78	29.50	44.79	27.02	27.26	45.47	-0.68	-18.46	-18.21	35.95	18.18	16.06	78.83	-42.88	-60.65	-62.77
CS-159	33.64	20.99	26.63	31.97	19.33	23.99	45.47	-13.50	-26.14	-21.48	23.64	10.99	10.80	78.83	-55.20	-67.84	-68.04
CHS-1	0.60	0.30	0.41	-5.94	-6.24	-8.39	45.47	-51.41	-51.71	-53.86	-38.64	-38.94	-52.38	78.83	-117.47	-117.77	-131.21
MARIAS/TETON SUBBASIN																	
MARIAS RIVER																	
Cut Bank	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
Shelby	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
Conrad	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
Chester	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
POI-10	57.30	35.42	54.89	57.30	35.42	54.89	37.08	20.21	-1.66	17.81	57.30	35.42	54.89	70.44	-13.15	-35.02	-15.55
CHI-53	53.98	33.37	53.79	53.98	33.37	53.79	37.08	16.90	-3.71	16.71	53.98	33.37	53.79	70.44	-16.46	-37.07	-16.65
PO-171	69.26	34.63	52.26	67.57	32.94	49.70	37.08	30.49	-4.14	12.62	59.10	24.47	36.92	70.44	-11.34	-45.98	-33.52
CHI-51	39.50	25.63	44.21	39.50	25.63	44.21	37.08	2.42	-11.45	7.13	39.50	25.63	44.21	70.44	-30.94	-44.81	-26.23
PO-271	36.23	24.74	39.79	36.23	24.74	39.79	37.08	-0.85	-12.34	2.71	36.23	24.74	39.79	70.44	-34.21	-45.70	-30.66
LI-161	52.38	26.19	39.30	48.82	22.63	33.96	37.08	11.73	-14.45	-3.12	31.02	4.83	7.25	70.44	-39.43	-65.61	-63.19
TO-341	49.02	24.51	38.46	46.36	21.85	34.28	37.08	9.27	-15.24	-2.80	33.03	8.52	13.37	70.44	-37.41	-61.92	-57.07
GL-221	53.95	26.97	35.98	51.67	24.70	32.95	37.08	14.59	-12.38	-4.13	40.31	13.34	17.80	70.44	-30.13	-57.10	-52.64
LI-162	46.40	23.20	35.10	42.10	18.90	28.60	37.08	5.02	-18.18	-8.48	20.62	-2.58	-3.90	70.44	-49.82	-73.02	-74.34
PO-251	31.00	21.16	33.88	29.50	19.67	30.61	37.08	-7.58	-17.41	-6.47	22.03	12.20	14.28	70.44	-48.41	-58.24	-56.16
GL-201	26.08	21.12	32.98	26.08	21.12	32.98	37.08	-11.00	-15.96	-4.11	26.08	21.12	32.98	70.44	-44.36	-49.32	-37.47

Table B-1 (continued)

				50 Mill (5 Cents) Per Kilowatt Hour Replacement Cost[b]							100 Mill (10 Cents) Per Kilowatt Hour Replacement Cost[c]						
	Consumptive Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value		
DRAINAGE/ Application	#1	Method[e] #2	#3	#1	Method[e] #2	#3	(Hydropower & Recreation)	#1	Method[e] #2	#3	#1	Method[e] #2	#3	(Hydropower & Recreation)	#1	Method[e] #2	#3
PO-411	28.85	19.70	31.71	25.94	16.79	25.32	37.08	-11.14	-20.29	-11.76	11.40	2.25	-6.65	70.44	-59.04	-68.19	-77.10
GL-11	46.39	23.20	30.84	43.55	20.36	27.07	37.08	6.47	-16.72	-10.01	29.36	6.17	8.20	70.44	-41.08	-64.28	-62.25
PO-211	27.37	18.69	30.67	24.61	15.93	24.48	37.08	-12.47	-21.15	-12.60	10.81	2.13	-6.44	70.44	-59.63	-68.31	-76.89
TO-221	22.29	15.22	26.24	19.92	12.85	20.66	37.08	-17.16	-24.23	-16.43	8.06	0.99	-7.26	70.44	-62.38	-69.45	-77.70
CHI-52	15.21	12.31	24.24	15.21	12.31	24.24	37.08	-21.87	-24.77	-12.84	15.21	12.31	24.24	70.44	-55.24	-58.13	-46.21
PO-421	33.58	16.79	22.37	29.89	13.10	17.46	37.08	-7.19	-23.98	-19.63	11.46	-5.33	-7.10	70.44	-58.98	-75.77	-77.54
LI-263	29.80	14.90	19.75	25.47	10.57	14.00	37.08	-11.61	-26.52	-23.08	3.78	-11.12	-14.73	70.44	-66.66	-81.56	-85.17
TO-342	17.90	8.95	13.87	13.50	4.56	7.06	37.08	-23.58	-32.52	-30.02	-8.45	-17.39	-26.96	70.44	-78.89	-87.84	-97.40
LI-262	20.48	10.24	13.30	15.45	5.21	6.77	37.08	-21.63	-31.87	-30.31	-9.69	-19.93	-25.87	70.44	-80.13	-90.37	-96.31
BS-32	15.78	7.89	12.07	10.32	2.43	3.72	37.08	-26.76	-34.65	-33.37	-16.98	-24.88	-38.04	70.44	-87.43	-95.32	-108.48
LI-261	15.53	7.77	10.08	11.48	3.72	4.82	37.08	-25.60	-33.36	-32.26	-8.77	-16.54	-21.45	70.44	-79.21	-86.98	-91.90
HI-269	9.66	4.83	6.25	4.34	-0.50	-0.64	37.08	-32.75	-37.58	-37.72	-22.30	-27.14	-35.13	70.44	-92.75	-97.58	-105.57
LI-91	9.33	4.67	6.11	3.91	-0.76	-1.00	37.08	-33.18	-37.84	-38.08	-23.24	-27.90	-36.55	70.44	-93.68	-98.35	-106.99
TO-421	7.53	3.77	5.86	7.53	3.77	5.86	37.08	-29.55	-33.31	-31.22	7.53	3.77	5.86	70.44	-62.91	-66.68	-64.58
PO-91	3.71	1.85	3.34	1.51	-0.34	-0.61	37.08	-35.57	-37.42	-37.69	-9.45	-11.30	-20.35	70.44	-79.89	-81.75	-90.79
BS-31	2.92	1.81	3.00	2.92	1.81	3.00	37.08	-34.16	-35.28	-34.08	2.92	1.81	3.00	70.44	-67.52	-68.64	-67.44
BSS-2	0.46	0.23	0.39	-4.62	-4.86	-8.23	37.08	-41.71	-41.94	-45.31	-30.06	-30.29	-51.32	70.44	-100.50	-100.73	-121.77
TO-211	-2.70	-1.35	-2.10	-9.05	-7.70	-11.98	37.08	-46.13	-44.78	-49.06	-40.77	-39.42	-61.38	70.44	-111.21	-109.86	-131.82
TETON RIVER																	
Choteau	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
TE-321	70.55	43.62	93.87	69.16	42.23	90.17	37.08	32.08	5.15	53.09	62.22	35.29	71.70	70.44	-8.22	-35.16	1.26
TE-361	40.80	26.48	92.37	38.85	24.52	83.52	37.08	1.76	-12.56	46.43	29.07	14.74	39.24	70.44	-41.37	-55.70	-31.20
CHI-61	57.71	35.68	89.10	57.71	35.68	89.10	37.08	20.63	-1.40	52.01	57.71	35.68	89.10	70.44	-12.73	-34.76	18.65
TE-591	115.11	82.93	87.15	114.24	82.06	85.84	37.08	77.16	44.98	48.75	109.90	77.72	79.26	70.44	39.45	7.28	8.82
TE-101	56.64	35.02	75.52	56.64	35.02	75.52	37.08	19.56	-2.06	38.44	56.64	35.02	75.52	70.44	-13.80	-35.43	5.08
TE-581	52.06	32.81	70.93	50.42	31.16	66.44	37.08	13.34	-5.92	29.36	42.18	22.93	44.01	70.44	-28.26	-47.51	-26.43
TEI-40	53.83	32.97	66.49	52.61	31.75	63.48	37.08	15.53	-5.34	26.40	46.51	25.65	48.41	70.44	-23.94	-44.80	-22.03
TEI-40	53.83	32.97	66.49	52.61	31.75	63.48	37.08	15.53	-5.34	26.40	46.51	25.65	48.41	70.44	-23.94	-44.80	-22.03
CHI-80	46.37	28.40	65.78	46.37	28.40	65.78	37.08	9.29	-8.68	28.70	46.37	28.40	65.78	70.44	-24.08	-42.05	-4.67
CHI-72	41.74	25.80	62.03	41.74	25.80	62.03	37.08	4.66	-11.28	24.95	41.74	25.80	62.03	70.44	-28.70	-44.64	-8.42
TEI-60	43.19	26.70	57.52	40.30	23.82	49.84	37.08	3.22	-13.27	12.75	25.88	9.39	11.42	70.44	-44.56	-61.05	-59.03
TEI-50	42.29	26.15	57.36	39.99	23.84	51.11	37.08	2.91	-13.24	14.03	28.46	12.32	19.85	70.44	-41.98	-58.12	-50.59
CHI-74	38.39	23.73	56.52	38.39	23.73	56.52	37.08	1.31	-13.35	19.44	38.39	23.73	56.52	70.44	-32.05	-46.71	-13.92
TE-411	29.04	19.83	47.19	29.04	19.83	47.19	37.08	-8.04	-17.25	10.11	29.04	19.83	47.19	70.44	-41.40	-50.61	-23.25
TEI-10	40.41	20.21	43.32	37.43	17.22	36.92	37.08	0.35	-19.86	-0.16	22.51	2.30	4.94	70.44	-47.93	-68.14	-65.50
TEI-30	38.79	19.39	42.37	35.98	16.59	36.24	37.08	-1.10	-20.49	-0.84	21.97	2.57	5.62	70.44	-48.48	-67.87	-64.82
TE-282	22.37	15.27	35.78	20.00	12.91	28.23	37.08	-17.08	-24.17	-8.85	8.20	1.10	-9.55	70.44	-62.24	-69.34	-79.99
TEI-20	24.66	16.00	33.73	24.66	16.00	33.73	37.08	-12.42	-21.08	-3.35	24.66	16.00	33.73	70.44	-45.78	-54.44	-36.71
TEI-70	22.54	13.94	30.19	19.63	11.03	22.40	37.08	-17.45	-26.05	-14.68	5.08	-3.52	-16.58	70.44	-65.36	-73.97	-87.02
TE-281	16.41	11.20	24.38	16.41	11.20	24.38	37.08	-20.67	-25.88	-12.70	16.41	11.20	24.38	70.44	-54.04	-59.24	-46.06
TE-401	21.23	10.62	23.18	19.81	9.19	20.08	37.08	-17.27	-27.89	-17.00	12.71	2.09	4.57	70.44	-57.74	-68.35	-65.88

Table B-1 (continued)

				50 Mill (5 Cents) Per Kilowatt Hour Replacement Cost[b]							100 Mill (10 Cents) Per Kilowatt Hour Replacement Cost[c]						
	Consumptive Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value		
	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]		
DRAINAGE/ Application	#1	#2	#3	#1	#2	#3		#1	#2	#3	#1	#2	#3		#1	#2	#3
TE-81	4.74	3.21	7.12	3.04	1.50	1.99	37.08	-34.05	-35.58	-35.09	-5.51	-7.05	-23.65	70.44	-75.95	-77.49	-94.10
CH-381	6.94	3.47	3.32	3.04	-0.43	-0.41	37.08	-34.04	-37.51	-37.49	-16.47	-19.94	-19.10	70.44	-86.91	-90.39	-89.55
CH-641	-10.09	-6.82	-19.09	-10.09	-6.82	-19.09	37.08	-47.17	-43.90	-56.17	-10.09	-6.82	-19.09	70.44	-80.53	-77.26	-89.53
MIDDLE MISSOURI SUBBASIN																	
MISSOURI RIVER - BELT CREEK TO FORT PECK RESERVOIR																	
Fort Benton	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
CH-21	71.26	44.05	55.42	69.82	42.62	53.19	37.08	32.74	5.54	16.11	62.64	35.44	42.02	70.44	-7.80	-35.01	-28.42
CH-551	67.84	33.92	50.29	67.84	33.92	50.29	37.08	30.76	-3.16	13.21	67.84	33.92	50.29	70.44	-2.60	-36.52	-20.15
CHI-21	45.98	31.40	41.16	43.30	28.72	36.37	37.08	6.22	-8.36	-0.71	29.91	15.32	12.39	70.44	-40.53	-55.12	-58.06
CHI-30	50.58	30.98	38.72	48.88	29.28	36.11	37.08	11.80	-7.80	-0.97	40.37	20.77	23.09	70.44	-30.07	-49.67	-47.35
CHI-22	40.50	27.95	36.30	37.75	25.20	31.38	37.08	0.67	-11.88	-5.71	24.01	11.46	6.74	70.44	-46.43	-58.98	-63.70
CH-201	54.31	27.16	36.05	54.31	27.16	36.05	37.08	17.23	-9.92	-1.03	54.31	27.16	36.05	70.44	-16.13	-43.29	-34.39
CH-181	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHI-10	37.14	25.63	33.51	34.57	23.06	28.88	37.08	-2.51	-14.02	-8.20	21.74	10.22	5.71	70.44	-48.71	-60.22	-64.73
CHI-40	48.69	30.10	28.70	48.69	30.10	28.70	37.08	11.61	-6.98	-8.38	48.69	30.10	28.70	70.44	-21.75	-40.34	-41.74
FEI-10	57.51	35.56	24.65	57.51	35.56	24.65	37.08	20.43	-1.53	-12.43	57.51	35.56	24.65	70.44	-12.93	-34.89	-45.79
BUREC	21.75	15.65	15.65	19.85	13.17	13.17	37.08	-17.23	-23.91	-23.91	10.36	0.77	0.77	70.44	-60.08	-69.67	-69.67
CHS-5	29.13	14.57	18.10	21.27	6.71	8.33	37.08	-15.81	-30.37	-28.75	-18.02	-32.59	-40.49	70.44	-88.46	-103.03	-110.93
CHS-3	26.54	13.27	17.84	24.71	11.44	15.38	37.08	-12.37	-25.64	-21.70	15.57	2.30	3.09	70.44	-54.87	-68.14	-67.35
CH-211	15.84	10.82	14.90	15.84	10.82	14.90	37.08	-21.24	-26.27	-22.18	15.84	10.82	14.90	70.44	-54.60	-59.63	-55.54
CH-541	9.87	7.03	8.30	9.87	7.03	8.30	37.08	-27.21	-30.05	-28.78	9.87	7.03	8.30	70.44	-60.57	-63.41	-62.14
CH-511	12.06	6.03	8.11	5.16	-0.87	-1.17	37.08	-31.92	-37.95	-38.25	-29.35	-35.38	-47.56	70.44	-99.79	-105.82	-118.00
FEI-30	15.17	9.29	6.26	15.17	9.29	6.26	37.08	-21.91	-27.79	-30.82	15.17	9.29	6.26	70.44	-55.27	-61.15	-64.18
FEI-20	10.39	7.10	5.22	10.39	7.10	5.22	37.08	-26.69	-29.98	-31.86	10.39	7.10	5.22	70.44	-60.05	-63.35	-65.23
CH-371	2.22	1.53	2.38	0.57	-0.12	-1.16	37.08	-36.51	-37.20	-38.24	-7.69	-8.37	-18.85	70.44	-78.13	-78.82	-89.29
CHS-6	-4.62	-2.31	-2.88	-10.27	-7.95	-9.92	37.08	-47.35	-45.04	-47.00	-38.48	-36.17	-45.09	70.44	-108.92	-106.61	-115.53
JUDITH RIVER																	
Winifred	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
Lewistown	586.70			583.45			35.69	547.76			567.15			69.05	498.10		
JBS-3	75.02	46.38	51.86	73.46	44.82	49.72	37.08	36.38	7.74	12.64	65.70	37.06	38.98	70.44	-4.75	-33.38	-31.47
FE-161	32.64	20.77	43.02	31.59	19.72	40.26	37.08	-5.49	-17.36	3.18	26.37	14.50	26.49	70.44	-44.08	-55.94	-43.95
FE-141	64.49	39.87	41.70	64.32	39.70	41.48	37.08	27.24	2.62	4.40	63.48	38.86	40.38	70.44	-6.97	-31.59	-30.06
FE-672	61.81	38.21	40.36	60.04	36.44	38.04	37.08	22.95	-0.64	0.96	51.18	27.58	26.47	70.44	-19.27	-42.86	-43.97
FE-673	51.60	31.90	33.46	49.75	30.06	31.07	37.08	12.67	-7.03	-6.01	40.54	20.84	19.12	70.44	-29.90	-49.60	-51.32
FE-671	49.12	30.37	32.12	46.00	27.25	28.04	37.08	8.92	-9.83	-9.04	30.41	11.66	7.66	70.44	-40.03	-58.78	-62.79
FE-431	42.63	29.11	31.68	40.15	26.63	27.99	37.08	3.07	-10.45	-9.09	27.75	14.22	9.56	70.44	-42.70	-56.22	-60.89
JB-261	29.94	24.24	28.90	29.94	24.24	28.90	37.08	-7.14	-12.84	-8.18	29.94	24.24	28.90	70.44	-40.51	-46.20	-41.54
JB-111	31.68	19.40	22.07	30.76	18.48	20.79	37.08	-6.32	-18.60	-16.29	26.17	13.89	14.40	70.44	-44.27	-56.55	-56.04
FE-401	38.86	19.43	19.13	37.07	17.64	17.36	37.08	-0.01	-19.45	-19.72	28.09	8.66	8.53	70.44	-42.35	-61.78	-61.91
FEI-40	28.22	17.45	18.35	22.91	12.14	11.44	37.08	-14.17	-24.95	-25.64	-3.65	-14.42	-23.10	70.44	-74.09	-84.86	-93.54

Table B-1 (continued)

				50 Mill (5 Cents) Per Kilowatt Hour Replacement Cost[b]							100 Mill (10 Cents) Per Kilowatt Hour Replacement Cost[c]						
	Consumptive Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value			Consumptive Value			Instream Value	Consumptive Value Minus Instream Value		
	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]			Method[e]			(Hydropower & Recreation)	Method[e]		
DRAINAGE/ Application	#1	#2	#3	#1	#2	#3		#1	#2	#3	#1	#2	#3		#1	#2	#3
JBI-2	23.77	14.69	16.36	19.60	10.52	10.62	37.08	-17.49	-26.56	-26.46	-1.25	-10.32	-18.08	70.44	-71.69	-80.77	-88.53
JB-231	20.01	13.81	15.87	17.49	11.28	11.87	37.08	-19.60	-25.80	-25.21	4.88	-1.33	-8.13	70.44	-65.57	-71.77	-78.58
JB-232	20.01	13.81	15.87	17.49	11.28	11.87	37.08	-19.60	-25.80	-25.21	4.88	-1.33	-8.13	70.44	-65.57	-71.77	-78.58
JB-21	25.78	17.60	15.82	24.15	15.97	13.81	37.08	-12.94	-21.11	-23.27	15.97	7.80	3.78	70.44	-54.47	-62.65	-66.66
FEI-50	7.98	5.13	5.40	1.15	-1.70	-3.84	37.08	-35.93	-38.78	-40.93	-32.99	-35.84	-50.07	70.44	-103.43	-106.28	-120.51
JB-309	2.90	1.98	2.25	1.28	0.36	-0.26	37.08	-35.80	-36.72	-37.34	-6.81	-7.73	-12.82	70.44	-77.25	-78.17	-83.26
FE-41	1.51	0.76	0.77	-3.98	-4.74	-4.83	37.08	-41.06	-41.82	-41.91	-31.46	-32.21	-32.85	70.44	-101.90	-102.65	-103.29
FE-111	0.63	0.45	0.56	0.63	0.45	0.56	37.08	-36.45	-36.63	-36.52	0.63	0.45	0.56	70.44	-69.81	-69.99	-69.88
FE-81	0.73	0.37	0.38	-1.98	-2.34	-2.41	37.08	-39.06	-39.42	-39.49	-15.52	-15.88	-16.37	70.44	-85.96	-86.33	-86.81
FE-42	-6.96	-4.70	-5.28	-6.96	-4.70	-5.28	37.08	-44.04	-41.78	-42.36	-6.96	-4.70	-5.28	70.44	-77.40	-75.14	-75.72
FE-561	-12.07	-6.03	-6.13	-17.21	-11.18	-11.36	37.08	-54.30	-48.26	-48.44	-42.96	-36.93	-37.51	70.44	-113.40	-107.37	-107.96
MUSSELLSHELL RIVER																	
LM-20	156.19	46.20	22.88	152.00	44.98	21.65	37.08	114.92	7.89	-15.43	131.03	38.83	15.51	70.44	60.59	-31.61	-54.94
FORT PECK RESERVOIR																	
VAS-1	16.33	8.16	12.20	13.71	5.55	8.29	37.08	-23.37	-31.53	-28.79	0.64	-7.53	-11.25	70.44	-69.80	-77.97	-81.69

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[a] All values in table are in dollars per acre-foot.

[b] The cost of replacing hydropower production and supplying additional electrical loads from new generating sources is assumed to be 50 mills per kilowatt hour.

[c] The cost of replacing hydropower production and supplying additional electrical loads from new generating sources in assumed to be 100 mills per kilowatt hour.

[d] Positive numbers indicate that benefits are greater than costs for consumptive uses, while negative numbers indicate costs of consumptive uses would be greater than the benefits of leaving water instream.

[e] These methods are explained in more detail in the "Benefits and Costs of Granting Reservations for Individual Projects" section in Chapter 2 of the Final EIS. Municipal values were derived using the same methodology used in the Draft EIS.

APPENDIX C

REVIEW OF METHODS USED TO RECOMMEND INSTREAM FLOWS FOR AQUATIC HABITAT

INTRODUCTION

To grant DFWP's requests, the Board must find that the methods used to determine the amount of water needed are "accurate and suitable" (ARM 36.16.107(3)). The Board's rules do not specify which methods are considered sufficiently accurate and suitable to reach a decision on proposed reservations, and the Board will have to weigh information in the EIS along with testimony presented at the contested case hearing before reaching its decision.

More than 70 methods are available to determine instream flow needs for fish and aquatic habitat (EA Engineering Science and Technology, Inc. 1986). Various reviewers have grouped these methods differently, but for convenience, three general categories are described in this appendix: Fixed Percentage Methods, Habitat Retention Methods, and Habitat Rating Methods.

FIXED PERCENTAGE APPROACHES

The least costly methods, requiring little or no field work, rely on flow statistics from past years. These methods recommend instream flows to maintain aquatic habitat based on a percentage of the monthly or annual flow. The Tennant Method (Tennant 1976) is one of the most frequently cited examples of this type. Tennant conducted detailed field studies on 11 streams east of the Continental Divide in Montana and two other states. "This work involved physical, chemical, and biological analyses of 38 different flows at 58 cross sections on 196 stream miles affecting both coldwater and warmwater fishes. These studies...reveal that the condition of the aquatic habitat is remarkably similar on most of the streams carrying the same portion of the average flow" (Tennant 1976). Tennant later looked at the flow regimes on 21 additional streams and found a similar relationship.

In the Tennant method, the mean annual flow for a stream is determined, and flow recommendations are based on percentages of the mean annual flow needed for a given level of fish habitat, as shown in Table C-1.

Loar and Sale (1981) wrote, "the median flow statistic is a more appropriate measure of central tendencies in hydrologic data than the mean flow." It might be more useful than the average flow in determining instream flow needs when using fixed percentage techniques.

Table C-1. Instream flow regimes for fish, wildlife, recreation, and related environmental resources

Description of flows for fish, wildlife, and recreation	Recommended base flow regimes	
	Oct-Mar	Apr-Sept
Flushing or maximum	200% of the average flow	
Optimum range	60-100% of the average flow	
Outstanding	40%	60%
Excellent	30%	50%
Good	20%	40%
Fair or degrading	10%	30%
Poor or minimum	10%	10%
Severe degradation	10% of average flow to zero flow	

Source: Tennant 1976

Another relatively simple method requiring no field work was proposed by the U.S. Fish and Wildlife Service for states in the New England region and is described by Loar and Sale (1981). The New England Flow Recommendation Policy advocates an instream flow equal to the median monthly flow on drainages with areas larger than 50 square miles and having accurate flow records for at least 25 years. Where this information is not available, a constant yield factor, runoff rate per watershed area, as calculated for the entire New England region, and is applied to the stream in question. Table C-2 summarizes this method. Similar though lower constant yield factors have been applied to the Connecticut River (Robinson 1969) and by Chaing and Johnson (1976) to streams in Pennsylvania.

Others have used flow-duration analysis to make instream flow recommendations. The Northern Great Plains Resource Program approach described in Loar and Sale (1981) uses a simple statistical test (student's t distribution) to identify and eliminate periods of flood and drought from daily flow records. The flow equaled or exceeded 90 percent of the time for each month after this elimination process is the recommended instream flow. Note that at least 20 years of records are necessary.

The state of Iowa has used the 84th percentile exceedance flow as the recommended instream flow when collection of extensive field data is not possible (Loar and Sale 1981).

Limitations of the fixed percentage method relate to the assumption that aquatic habitat responds

Table C-2. Seasonal instream flow recommendations (= aquatic base flows) for rivers in New England with different flow records.

Values are expressed as cubic meters per square kilometer and cubic feet per second per square mile (in parentheses)

	Availability of historical flow records	
Season	More than 25 years	Less than 25 years[a]
Spring[b] (April - mid June)	0.29 (4.0)	100% median monthly flow[c]
Summer (mid June - Sept.)	0.04 (1.0)	100% median monthly flow[c]
Fall/winter[b] (October - March)	0.07 (0.5)	100% median monthly flow[c]

[a] Other criteria, in addition to record length, that are used to decide whether to accept/reject the gauging record include: (1) ±10% accuracy, or better; (2) drainage basin is greater than 130 km^2 (50 sq miles); (3) river is unregulated.

[b] Spawning/incubation periods

[c] If reservoir inflow is less than median monthly flow, then outflow = inflow.

Source: Loar and Sale 1981

consistently to varying hydraulic regimes among streams in different locations. According to Loar and others (1986), this assumption ignores the fact that hydraulic geometry and local aquatic populations are adapted to local hydrologic conditions and assumes that these conditions can be accurately represented by particular flow statistics. Fixed percentage approaches do not consider a stream's unique features that influence fish populations and do not provide for development of a site-specific recommendation based on these features (Loar et al. 1986). Lastly, these methods do not allow correlation of a given flow rate to a given number or weight of fish a stream could produce.

Results of the fixed percentage method are compared to results of DFWP's analysis in Table C-8. Thirty percent of the average annual flow was used because, as described later, other researchers have found this could be considered a generally safe starting point for making instream flow recommendations. In comparing methods for determining instream flows, it is necessary to understand the limitations and assumptions behind fixed percentage approaches and understand that on ungauged streams, the accuracy of these methods would depend, in part, on the accuracy of the estimate of the average annual flow. It should be emphasized that fixed percentage methods do not consider the characteristics of individual streams.

HABITAT RETENTION METHODS

Habitat retention methods use criteria set at a level below which flow rates should not fall in order to retain one or more aspects of aquatic habitat, such as minimum depth, minimum width, or wetted perimeter. Habitat retention methods require the collection of field data from streams where recommendations are sought. Collecting field data specific to an individual stream overcomes one shortcoming of fixed percentage approaches. For the sake of discussion, DFWP's WETP method is included in this category, though some reviewers would treat it separately. Habitat retention methods assume that one or more physical characteristic of a stream channel can be used as substitutes for factors that limit stream biota or fish populations (Loar et al. 1986), but habitat retention methods cannot be used to predict changes in fish numbers or biomass with changes in flow. Typically, measurements of width, depth, wetted perimeter, or velocity are made at one (critical) or more (representative) stream cross sections to quantify certain aspects of aquatic habitat. Measurements are made at transects placed in riffles or in a combination of pools, runs, and riffles. One of several hydrologic modeling techniques is used to predict how water elevation (stage) changes in relation to discharge (flow). This relationship is then used to predict how width, depth, or wetted perimeter respond to a change in flow. Table C-3 summarizes several habitat retention methods.

The water surface profile program (WSP) is one modeling technique used to predict how water elevation (stage) changes in relation to flow. WSP was used by DFWP in portions of its application to reserve water in the Yellowstone River basin and on two streams in its application to reserve water in the Missouri River basin. Use of stage-discharge relationship based on regression analysis of at least three field measurements of stage and discharge allows more precise predictions of how stage changes in relation to changing flow. The stage-discharge approach was adopted by DFWP on all but two streams.

HABITAT-RATING METHODS

Habitat-rating methods rely on determinations of which habitats fish prefer and computer models to

Table C-3. Summary of the common "habitat retention" methods used to determine rearing flow requirements (derived from Wesche and Rechard 1980)

Method	Species	Habitat unit considered	Rearing criteria
Oregon	salmonids	riffles	- adequate depth - 60% wetted - velocity 1.0 to 1.5 ft/sec
		pools	- velocity 0.3-0.8 ft/sec - pool/riffle ratio near 50:50
Colorado (USFS Region 2)	salmonids	riffles	- 50% wetted - average velocity 1.0-1.5 ft/sec - depth 0.2-0.4' if width less than 20' 0.5-0.6' if width more than 20'
USFS Region 4	salmonids	all units (pools, riffles, runs, etc.)	- percentage of "index" habitat retained at reduced discharges
USFS Region 6	salmonids	"typical rearing habitat"	- depth 0.5-3.0 ft - velocity 0.2-1.6 ft/sec
Washington	salmonids	riffle/pool sequence	- inflection point on wetted perimeter: discharge curves
Idaho	warmwater	riffles	- inflection point on wetted perimeter: discharge curves
Montana's WETP	salmonids	riffles	- inflection point on wetted perimeter: discharge curves

Source: Adapted from Leathe and Nelson 1989

predict how much preferred habitat is available at a given flow. The most commonly mentioned habitat-rating approach is the Instream Flow Incremental Method (IFIM), which is still being refined by the Instream Flow Group (IFG) at Fort Collins, Colorado. IFG has developed a series of computer programs to assist in implementing IFIM. As a group these programs are referred to as the physical habitat simulation model (PHABSIM). IFIM is similar to but more sophisticated than a method used by Pacific Gas and Electric in northern California (Waters 1976). While IFIM is considered the most advanced technique, it, like the previously mentioned methods, is generally incapable of predicting fish numbers, biomass, survival rate, or carrying capacity of a stream.

Sale and Loar (1982) described the method as follows:

> The basic approach to habitat modeling employed by the Incremental Methodology begins by selecting a representative stream reach and dividing it into a matrix of discrete mapping cells centered along several transects spaced through the reach. Depth (d_i) and mean water column velocity (v_i) are predicted in each cell using computer simulation techniques (Bovee and Milhous 1978). Two different hydraulic modeling procedures can be applied: (1) a modified step-backwater model based on the Manning equation, the Bernoulli equation, and conservation of flow, or (2) a stage-discharge regression model. Bottom substrate type (s_i) is assigned a fixed value for each mapping cell and is assumed to be independent of flow. Cover and water temperature can also be included to describe the physical habitat.
>
> The calculation of weighted useable area (WUA) combines two components of habitat condition (quality and quantity) into a single index unique for each life stage of a target species. Habitat quantity is measured by the surface area of each mapping cell; habitat quality is measured by a multivariate parameter called composite suitability

which is a function of the physical parameters of each cell (e.g., depth, velocity, substrate, cover, and/or temperature). WUA is then calculated as follows:

$$\mathrm{WUA} = \sum_{i=1}^{n} S_i * a_i, \qquad (2)$$

where

S_i = composite habitat suitability for ith cell,

a_i = surface area of the ith cell, and

n = total number of cells.

WUA has units of area per length of stream (e.g., m^2/km). Equation 2 has the effect of equating an area of suboptimal habitat to a smaller area of optimal habitat, implying an equivalent utilization of the two stream conditions by fish.

The concept of habitat suitability is introduced as a relative measure of the behavioral tolerances of individual life stages of target species (Bovee and Cochnauer 1977). All suitability functions take on values ranging between zero and one. Although several techniques can be used to calculate composite suitability, the most commonly used form is a multiplicative equation assuming independence among the physical parameters of depth, velocity, substrate, cover, and/or temperature within each cell. For example, when only depth, velocity, and substrate are included,

$$S_i = S_d(d_i) * S_v(v_i) * S_s(s_i)\,, \qquad (3)$$

where

$S_d(\bullet), S_v(\bullet), S_s(\bullet)$ = univariate suitability functions determined for each life stage of a target fish species, and

d_i, v_i, s_i = depth, velocity, and substrate predicted for the ith mapping cell.

The habitat response curves (WUA vs. discharge) are utilized in a number of ways to make minimum flow recommendations. One technique suggested by the IFG is to find the stream flow for each month that minimizes the deviations from optimal habitat conditions for each life stage present for an affected fish species. This optimal flow is constrained to fall between the median monthly flow and the 90th percentile monthly flow and is used as the minimum flow recommendation for normal years. The habitat response curves can also be used to (1) calculate habitat duration curves to quantify preproject conditions and provide a baseline for setting minimum flows, (2) test alternative operating schedules with time-services simulation of habitat, or (3) form objective functions in formal optimization models of single or multiple reservoir systems.

The IFIM is not without drawbacks. Mathur and others (1984) critiqued the method, and found that the assumption that IFIM could predict changes in fish biomass is untested, especially in warmwater environments. Also, the assumption that fish select habitat variables independent of one another has not been tested, although Sale and Loar (1982) note that, while untested, these assumptions provide at least a practical approach to representing fish behavior.

COSTS OF VARIOUS METHODS

There is a considerable difference in the amount of work and cost required to implement each of these methods with the more sophisticated methods generally requiring more resources. Loar and Sale (1981) suggest the time requirements shown in Table C-4.

VALIDATION OF DFWP'S WETP METHOD

The WETP method is based partially on the assumption that "aquatic organisms which make up the majority of food for gamefish are produced in riffle areas and that food supply for the fish is a major factor in determining the number and weight of fish a stream can support during the warmer months when fish grow and new fish are recruited into the population." (DFWP 1991)

Table C-4. Generalized time requirements of various methods to determine instream flow needs on one stream reach

General method	Manpower requirement (person days/stream reach)	Requires travel
Fixed percentage	1	no
Habitat retention	7-10	yes
Habitat rating (IFIM)	10-40+	yes

Information in Brown (1971) and studies conducted by Needham (1934) and Briggs (1948) lend support to the assumption that most food organisms used by Montana game fish are produced in riffles. If greater amounts of riffle areas remain wet, in theory more food production would take place, though the well-being of fish is questionable when flows reach flood stage. In addition, each aquatic insect may have a preferred range of velocities, depths, and substrate types.

A study was begun in 1988 at the Cooperative Fisheries Research Unit at Montana State University to evaluate the role of riffle food supply in regulating fish populations during the summer. Results of this study are not expected until the spring of 1992 (White 1991).

Cada and others (1983) compared the results of the wetted perimeter analysis to the production of food organisms used by trout in Appalachian streams. This preliminary study tested the assumption that the wetted perimeter should reflect the density of aquatic organisms used for food by fishes under varying flows. For most of the sites and organisms examined, the density of food organisms did not show a consistent relationship to changes in wetter perimeter.

Randolph and White (1984) studied the response of rainbow trout to reductions in flow in Ruby Creek, a Madison River tributary. They also tested the hypothesis that average riffle wetted perimeter can be used as a general index of adult salmonid habitat suitability in small streams. They found that summer flow has a regulating influence on rainbow trout numbers and biomass. However, Randolph and White concluded:

> [The] wetted perimeter was not a consistent index of summer habitat suitability for rainbow trout in Ruby Creek. In the pool-riffle section, wetted perimeter was highly correlated with trout numbers and biomass and the inflection point on the wetted perimeter curve corresponded closely with the flow at which rate of trout emigration increased substantially. Correlation between riffle wetted perimeter and trout numbers in the two run-riffle sections was poor. In one run-riffle section, the wetted perimeter inflection point corresponded to a flow which would substantially underestimate the flow we observed to be optimum. In the other run-riffle section, which had two wetted perimeter inflection points, one would overestimate the optimum summer flow while the second would slightly underestimate that optimum.

COMPARISON OF METHODS

Annear and Conder (1983, 1984) studied 18 methods (Table C-5) on 13 Wyoming trout streams with average flow rates ranging from 3.5 to 14,000 cfs. Most of these streams were affected by irrigation. The authors of this study compared the results from these 18 methods to determine objectively whether a particular method was biased when compared to other methods. The authors defined "unbiased" to indicate that results from a given method fell within the range designated as the average of all 18 methods (mean plus the 95 percent confidence interval).

After comparing the results of Tennant's method (using 30 percent of the average annual flow) to 17 other methods, Annear and Conder (1984) concluded, "...this method may provide a generally safe starting point for determining/developing instream flow recommendations." Annear and Conder found that use of 10 percent of the average annual flow as the maintenance flow consistently underestimated maintenance flows predicted by other methods.

The wetted perimeter method equivalent to the one used by DFWP fell within the unbiased range on 7 of the 13 streams Annear and Conder studied. On the 6 remaining streams, needed flows were overestimated. Annear and Conder observed: "This may be acceptable in some cases because if the recommendation were to be found in error at a later date it would be preferable to overestimate than underestimate flow needs. This creates the flexibility to negotiate downwards after making preliminary recommendations, which may be easier than negotiating for higher flows." Three of the six upwards-biased minimum flow estimates for both the riffle and all-habitat categories greatly exceeded available late summer flows. This could create rather than resolve instream flow conflicts by damaging a biologist's credibility or falsely implying a need for upstream storage of water (Annear and Conder 1984).

They also stated: "A major drawback with this method is that inflection points are chosen solely on a subjective basis and recommendations can vary between investigators. Complications also arise when no clearly defined inflection is found or where multiple inflections occur on a curve. As the name of the method implies, subjective methods reflect the

Table C-5. The number of times that results for each method were within the defined maintenance flow range (unbiased) or were biased relative to the defined range on 13 trout streams

Method	Unbiased	Biased low	Biased upwards	Relative bias[b]
Tennant				
30% of annual flow	10	3	0	U[c]
10% of annual flow	0	13	0	L[c]
Wetted Perimeter				
Riffles only:				
Subjective	7	0	6	H[c]
2 times annual flow minus LSD[a]	6	4	3	U
Annual flow minus LSD[a]	6	7	0	L[c]
All habitat:				
Subjective	7	0	6	H[c]
2 times annual flow minus LSD[a]	4	3	6	H
Annual flow minus LSD	6	5	2	L
Habitat Retention				
3 of 3 criteria met:				
Mean of all habitats	8	3	2	U
Mean of riffles only	10	0	3	U[c]
Most critical riffle	5	0	8	H[c]
2 of 3 criteria met:				
Mean of all habitats	1	12	0	L[c]
Mean of riffles only	1	12	0	L[c]
Most critical riffle	10	3	0	U[c]
Physical habitat simulation models				
IFG-2:				
Optimization matrix	3	3	7	H
Preferred flow minus LSD[a]	6	2	5	H
IFG-4:				
Optimization matrix	4	3	6	H
Preferred flow minus LSD[a]	3	8	2	L

[a] LSD = least significant difference resulting from Fisher's multiple mean comparison.

[b] U = unbiased; L = biased low; H = biased upwards

[c] significant at $P < 0.05$

Source: Adapted from Annear and Conder (1984)

user's bias to some degree. This does not imply that bias is always a detriment." (Annear and Conder 1984)

Annear and Conder (1984) also examined variations of a habitat retention method used by the Colorado Division of Wildlife (Nehring 1979). The authors found that applying the Colorado Division of Wildlife (Table C-5) criteria to the average of several riffles and for the most critical riffle each resulted in unbiased results for 10 of the 13 streams studied.

When compared to other methods, Annear and Conder found that IFG's habitat-rating method relying on PHABSIM models were not significantl unbiased, and on small streams (less than 30 cfs average annual flow) would provide high minimum flow estimates and on large streams (greater than 100 cfs average annual flow) would give relatively low results.

Nelson (1980) conducted another study comparing methods. He made instream flow recommendations based on long-term trout standing crop and flow data. He then evaluated several instream flow methods to determine how well their predictions would match the established flow requirements. In

Table C-6. Key flow parameters used to determine minimum flow requirements using habitat retention[a]

Stream width (ft)	Average depth (ft)	Average velocity (ft/sec)	Wetted perimeter (%)
Riffle habitat type			
1-20	0.2 or greater	1.0	50
21-40	0.2-0.4	1.0	50
41-60	0.4-0.6	1.0	50 to 60
61-100	0.6-1.0	1.0	70 or greater
Run habitat type			
1-20	0.2 or greater	0.5	50
21-40	0.2-0.4	0.5	50
41-60	0.4-0.6	0.5	50 to 60
61-100	0.6-1.0	0.5	70 or greater
Pool habitat type			
1-20	0.4 or greater	0.1	50
21-40	0.4-0.8	0.1	50
41-60	0.8-1.2	0.1	50 to 60
61-100	1.2-2.0	0.1	70 or greater

[a] Rivers in excess of 100 feet in wetted perimeter are judged on individual channel characteristics as related to key flow parameters. Parameters apply to instream flow recommendations for the period of May to September. October to April flow recommendations will be at the same level or at the natural undepleted flow, whichever is less.

Instream flow recommendations in cfs are selected when minimum levels of two or more parameters are reached within the designated stream class. Average depth evaluation is based on maximum body depth of the largest fish present and is considered one of the most important flow parameters. Body depth is defined as the distance from the tip of the extended dorsal fin to the lowest portion of the body cavity.

Source: Annear and Conder (1984)

particular, two of these instream flow methods are similar to those now used by DFWP. In the multiple transect method examined by Nelson, the transects were located in several habitat types, not just riffles. The single transect method used one transect located in a riffle. According to Nelson:

> Recommendations derived from the four methods were compared to those derived from long-term trout standing crop and flow data. The trout-flow data generally provided two minimum flow recommendations for each reach. Flows less than the *absolute minimum* recommendation appear to lead to substantial reductions in the standing crops of adult trout or the standing crops of a particular group of adults, such as trophy-size trout. Flows greater than the *most desirable minimum* recommendation sustained the highest standing crops. The optimum flow should either equal or exceed the most desirable minimum.
>
> The recommendations generated by the single transect method for all five reaches compare favorably to the absolute minimums derived from the trout-flow data. Single, well defined inflection points were generally present and easily interpreted. In addition to providing reliable and consistent recommendations, the single transect method also was the most time and cost efficient of the three field methods.
>
> The multiple transect method provided acceptable absolute minimum recommendations for the four reaches having discernible inflection points. Inflection points, when present, were generally not as well defined as those on the wetted perimeter curves derived for the single transect method. In the two reaches having more than one inflection point, the lowermost occurred at the flow approximately equal to the absolute minimum recommendation. While the multiple transect method did provide acceptable absolute minimum recommendations for four of the reaches, it had no advantage over the single transect method. It was costlier, more time consuming, sometimes difficult to interpret, and occasionally unproductive (Nelson 1980).

Only during the low flow season (July-December) did Orth and Maughan (1982) find that flow recommendations based on Tennant's method and wetted perimeter were similar to those found using the Instream Flow Group's incremental methodology. They studied an unregulated creek in southeast Oklahoma. The primary game fish in their study was the smallmouth bass. Most of the game and nongame species in this study are not found in the Missouri River drainage above Fort Peck.

OTHER CONSIDERATIONS

DFWP supplemented results of WETP analysis with additional information pertaining to flows needed to maintain side channel habitat used for spawning and rearing, flows necessary to allow paddlefish migration in the Missouri River, and flows necessary to allow spawning in several tributary streams. This type of information provides additional insight into instream flows needed to protect nonriffle habitats. Other studies also have examined the change in availability of side channel habitat in relation to changing streamflows (Klinger-Kingsley et al. 1985) although the methods differ.

During the Clark Fork reservation proceeding, DNRC checked the accuracy of the model DFWP used to predict wetted perimeter. DNRC wrote another program and compared the results it produced to those produced by DFWP's model. Based on a comparison of results for four segments of the Clark Fork River, Flint Creek, and Boulder Creek, DNRC's results did not differ substantially from DFWP's. Since DFWP's WETP method used in the Clark Fork reservation proceeding was the same as that used in the Missouri basin, DNRC believes that, when properly implemented, the WETP method accurately portrays the amount of riffle bottom remaining wet as flows change.

One of the keys to DFWP's model is the prediction of stage (water surface elevation) at unmeasured flows. The rating curve for each cross-section can be described by the equation:

$Q = p\,(S - zf)^n$ where:
Q = discharge (i.e. flow rate)
p = a constant
S = stage height
n = a constant exponent
zf = stage height at zero flow

This equation assumes (1) flows are not rapidly changing when the measurements are made, (2) changes in roughness effects of the stream bottom and streambanks do not change substantially as flows change, (3) sediment transport conditions do not change, and (4) cross-sectional shapes do not change (Gray 1970).

One of the key factors in DFWP's model for determining wetted perimeter is the accuracy of the stage-discharge relationship. This is the relationship between water elevation (stage) and flow rate (discharge). There is greater potential for error in defining the stage-discharge relationship if only two measurements, the minimum, are used. When only two measurements of stage and discharge are made, the potential for introducing error into extrapolations can be reduced by incorporating the stage at zero flow into the calculations, ensuring that the higher calibration flow is at least twice as high as the lower one, and restricting the range of extrapolation allowed. DFWP implemented these measures, but "two-point error" may have occurred on at least some of the 21 stream segments identified in Table C-7 where only two measurements of discharge were used.

DFWP has applied to reserve high spring flows on portions of the Missouri River to allow paddlefish migration, but the legal limit on the amount of water that can be reserved for instream purposes is likely to prevent the Board from granting the requested instream flows during the spring.

The Board may wish to consider the number of riffle cross-sections used in DFWP's WETP analysis. The use of several riffle cross-sections tends to deemphasize the importance of any one riffle cross-section in making a determination of instream flow needs. If only one riffle cross-section is used, there is a chance that it is not representative of other riffles in this area under study, and resulting instream flow recommendations may be higher or lower than recommendations made using a larger number of cross-sections. Table C-7 lists the number of riffle cross-sections studied when the WETP method was used.

DFWP used a fixed percentage method on 27 steams indicated in Table B-2 of the daft EIS. This method, like the Tennant method, gives an approximation of instream flow needs but does not rely on field information collected on the stream where the request is being made. In this sense, it is less precise than the WETP method.

Trihey and Stalnaker (1985) have been involved for many years in the application and development of instream flow methods. Dr. Stalnaker is the leader of the Instream Flow Group that has developed the most advanced instream flow methodology. Trihey and Stalnaker (1985) addressed the issue of which methods are appropriate for which types of decisions regarding instream flows. They found that procedures such as the WETP method used by DFWP are appropriate for protecting the existing instream resource in state water plans and state water allocation such as permits or reservations, and for identifying target flows for use during project feasibility studies.

More advanced incremental methods such as the Instream Flow Group's instream flow incremental method are most appropriate for time series analysis to identify limiting flow conditions, fine-tuning a resource maintenance objective (maximum utilization of available water), avoiding or minimizing flow-related impacts for specific projects, and comparing mitigation alternatives. The Instream Flow Group's method is considered the most advanced.

Table C-7. Methods DFWP used to estimate needed instream flows

Stream	Request	Method[a]	Flow (cfs) corresponding to: Upper inflection point	Flow (cfs) corresponding to: Lower inflection point	Number of riffle cross sections			Flow (cfs) measured to determine stage-discharge relationships		
GALLATIN RIVER DRAINAGE										
Baker Creek	14.0	WETP	14.0	6.0	5	20.2	73.1	84.6		
Ben Hart Spring Creek	29.0	BF								
Big Bear Creek	2.0	WETP	3.5	2.0	3	6.5	27.1	39.1		
Bridger Creek	18.3*	ALL	14.0	--	2	29.0	54.6	94.4		
Cache Creek	2.6	WETP	2.6	1.2	5	1.8	4.4	8.0		
East Fork Hyalite Creek	7.0	WETP	7.0	4.0	5	9.0	16.4	55.7		
East Gallatin River #1	42.4*	ALL								
East Gallatin River #2	90.0	WETP	90.0	50.0	1	68.3	234.4			
East Gallatin River #3	170.0	WETP	170.0	--	1	199.0	337.0			
Gallatin River #1	170.0	WETP	170.0	--	2	236.0	342.0	462.0		
Gallatin River #2	400.0	BIO								
Gallatin River #3	533.5*	WETP	1000.0	500.0	2	414.0	539.0	1250.0		
Hell Roaring Creek	16.0	FP								
Hyalite Creek #1	28.0	WETP	28.0	14.0	2	20.7	61.9	102.0		
Hyalite Creek #2	16.0	WETP	40.0	16.0	2	42.5	101.4			
Middle Fork of West Fork Gallatin R.	3.0	WETP	6.0	--	2	16.6	32.1	63.0		
Porcupine Creek	4.5	WETP	6.0	3.0	4	7.1	13.2	32.8		
Reese Creek	5.0	WETP	5.0	--	2	17.1	46.4			
Rocky Creek	51.0	ALL	16.0	6.0	2	21.7	61.1	89.2		
Sourdough Creek	35.9	ALL	11.0	6.0	2	12.3	34.1	69.6		
South Cottonwood Creek	14.0	WETP	14.0	6.0	5	24.3	34.5	85.4		
South Fork Spanish Creek	15.0	WETP	15.0	8.0	5	16.1	65.0	124.9		
South Fork of West Fork Gallatin River	5.0	WETP	12.0	5.0	2	19.1	38.4	77.4		
Spanish Creek	70.0	WETP	70.0	--	2	55.5	115.7	157.6		
Squaw Creek	12.0	WETP	12.0	6.0	5	23.5	49.4	60.6		
Taylor Fork	36.0	WETP	36.0	16.0	3	47.2	101.6	256.0		
Thompson Spring Creek	29.0	BF								
West Fork Gallatin River	26.0	WETP	26.0	14.0	5	27.8	58.6	162.0		
West Fork Hyalite Creek	12.0	WETP	12.0	7.0	5	12.1	22.0	68.7		
MADISON RIVER DRAINAGE										
Antelope Creek	14.0	BF								
Beaver Creek	937.0	HEBGEN	22.0	16.0	3	61.9	103.8	141.0		
Black Sand Spring Creek	18.7	BF								
Blaine Spring Creek	23.0	BF								
Cabin Creek	585.0	HEBGEN	22.0	11.0	2	30.6	53.7	102.7		
Cherry Creek	15.0	WETP	15.0	10.0	3	28.2	36.1	91.2		
Cougar Creek	24.0	FP								
Duck Creek	23.0	FP								
Elk River	28.0	FP								
Grayling Creek	34.0	WETP	34.0	18.0	2	49.5	91.3	143.7	265.7	466.6
Hot Springs Creek	5.5	WETP	5.5	2.0	2	9.5	20.2	31.9		
Indian Creek	48.0	WETP	48.0	22.0	2	45.9	71.3	88.4		
Jack Creek	28.0	WETP	28.0	18.0	2	41.6	58.3	79.7		
Madison R. #1 above Hebgen	245.0*	WETP	500.0	240.0	4	627.0	694.0	909.0		
Madison R. #2 above W.Fork	502.5*	WETP	800.0	--	1	918.0	1211.0	1555.0		
Madison River #3 above Ennis	716.0*	WETP	1000.0	350.0	3	1100.0	2058.0			
Madison River #4 above mouth	825.0*	BIOL	1300 REQUESTED							
Moore Creek	1.4	FP								
North Meadow Creek	18.0	WETP	18.0	9.0	2	17.9	28.4	68.1		
O'Dell Spring Creek	98.0	BF								
Red Canyon Creek	2.9	FP								
Ruby Creek	18.0	WETP	18.0	7.0	3	10.2	12.4	21.2	41.4	
South Fork Madison River	92.0	BF								
Squaw Creek	14.0	WETP	14.0	5.0	3	5.6	30.8	49.3		
Standard Creek	10.0	WETP	10.0	6.0	4	18.2	28.0	62.9		

Table C-7 (continued)

Stream	Request	Method[a]	Flow (cfs) corresponding to:		Number of riffle cross sections	Flow (cfs) measured to determine stage-discharge relationships			
			Upper inflection point	Lower inflection point					
Trapper Creek	3.2	FP							
Watkins Creek	5.5	FP							
West Fork Madison River	957.0	HEBGEN	42.0	22.0	3	67.3	93.0	181	
JEFFERSON AND BOULDER RIVER DRAINAGES									
Boulder River #1 above High Ore Creek	20.0	WETP	20.0	14.0	3	41.0	68.1	206.5	
Boulder River #2 above Cold Spring	24.0	WETP	24.0	8.0	1	18.6	61.4	309.2	
Boulder River #3 above mouth	47.0	WETP	68.0	25.0	1	54.9	203.1	224.2	
Halfway Creek	1.9	FP							
Hells Canyon Creek	3.6	WETP	3.6	2.0	2	5.7	7.1	13.9	
Jefferson River	1095.5*	WETP	1100.0	550.0	3	1015.0	2385.0	7350.0	
Little Boulder River	7.0	WETP	7.0	3.0	2	9.5	23.7	39.3	
North Willow Creek	7.0	WETP	7.0	3.0	4	8.2	8.7	18.2	
South Boulder River	12.0	WETP	12.0	8.0	2	41.3	75.0	162.4	
South Willow Creek	14.0	WETP	14.0	--	2	18.8	35.7	77.7	
Whitetail Creek	3.0	WETP	3.0	1.4	2	4.4	7.3	26.4	
Willow Creek	14.0	WETP	14.0	7.0	2	39.9	105.6	162.1	
Willow Spring Creek	9.2	BF							
BIG HOLE RIVER DRAINAGE									
American Creek	2.8	WETP	2.8	1.8	4	6.7	11.2	16.6	31.8
Bear Creek	2.8	WETP	2.8	0.6	5	3.8	11.3	33.4	
Big Hole R. #1 above Pintlar Creek	160.0	WETP	160.0	60.0	4	1.0	68.0	340.0	
Big Hole R. #2 abv Old Divide Dam	800.0	WETP	800.0	--	5	367.0	466.0	468.0	812.0
Big Hole R. #3 above mouth	573.0*	WETP	650.0	260.0	4	55.0	543.0	1450.0	
Big Lake Creek	4.7	FP							
Birch Creek	10.0	WETP	18.0	10.0	2	17.6	85.4	161.2	
Bryant Creek	1.4	WETP	1.4	0.8	2	3.3	9.6	11.2	
California Creek	14.0	WETP	14.0	10.0	3	14	43.1	94.6	
Camp Creek	5.0	WSP	5.0	--	1	14.2			
Canyon Creek	5.0	WETP	5.0	3.0	2	4.2	15.3	48.2	
Corral Creek	1.0	WETP	1.0	0.6	3	1.8	5.0	8.7	
Deep Creek	18.0	WETP	18.0	10.0	1	33.8	187.5		
Delano Creek	0.3	FP							
Divide Creek	3.0	WETP	3.0	1.6	3	3.0	12.2		
Fishtrap Creek	10.0	WETP	10.0	4.5	2	8.2	86.5		
Francis Creek	4.0	WETP	4.0	1.0	1	3.7	63.1		
French Creek	6.0	WETP	6.0	3.0	1	10.6	56.3		
Governor Creek	4.0	WETP	4.0	2.0	2	8.0	35.8		
Jacobson Creek	14.0	FP							
Jerry Creek	7.0	WETP	7.0	3.0	5	0.5	4.8	9.9	
Johnson Creek	13.0	WETP	13.0	5.0	1	5.4	56.4		
Joseph Creek	5.0	WETP	5.0	0.8	2	3.5	14.6	35.5	
LaMarche Creek	11.0	WETP	11.0	5.0	1	9.1	25.0	158.2	
Miner Creek	9.0	WETP	9.0	4.0	1	13.1	99.1		
Moose Creek	9.0	WETP	9.0	2.0	1	13.1	35.2		
Mussigbrod Creek	10.0	WETP	10.0	3.0	3	4.3	71.8		
North Fork Big Hole River	30.0	WETP	30.0	--	2	26.8	183.8		
Oregon Creek	0.3	WETP	0.3	--	2	0.5	4.7	8.9	
Pattengail Creek	12.0	WETP	44.0	12.0	2	22.8	111.3		
Pintlar Creek	10.0	WETP	10.0	4.0	5	2.0	97.1		
Rock Creek	5.0	FP							
Ruby Creek	4.0	WETP	4.0	1.2	2	5.3	30.5		
Sevenmile Creek	1.8	WETP	1.8	0.8	3	1.8	5.7	12.7	
Seymour Creek	13.0	WETP	13.0	7.0	3	10.1	55	87.6	
Sixmile Creek	1.6	WETP	1.6	0.6	4	1.8	3.2	6.6	21.5
South Fork Big Hole River	22.0	WETP	22.0	10.0	2	21.2	150.5	306.9	
Steel Creek	6.0	WETP	6.0	2.0	2	3.2	21		
Sullivan Creek	4.0	WETP	4.0	--	2	5.1	19.4	50.1	

Table C-7 (continued)

Stream	Request	Method[a]	Flow (cfs) corresponding to: Upper inflection point	Flow (cfs) corresponding to: Lower inflection point	Number of riffle cross sections	Flow (cfs) measured to determine stage-discharge relationships			
Swamp Creek	8.0	WETP	8.0	4.0	2	7.6	74.6		
Tenmile Creek	3.8	WETP	3.8	1.4	3	5.9	18.4	44.0	
Trail Creek	14.0	WETP	14.0	6.0	2	17.8	108.1		
Trapper Creek	3.2	WETP	3.2	1.8	2	4.8	18.8	24.7	
Twelvemile Creek	1.2	WETP	1.2	0.8	2	1.8	7.7	16.9	24.5
Warm Springs Creek	20.0	WETP	20.0	5.0	2	14.8	86.9		
Willow Creek	16.0	WETP	16.0	7.0	2	9.3	43.8	59.2	
Wise River	35.0	WETP	35.0	20.0	2	43.0	66.1	418.5	
Wyman Creek	7.0	FP							
RUBY RIVER DRAINAGE									
Coal Creek	3.6	FP							
Cottonwood Creek	4.0	WETP	7.0	4.0	2	5.3	22.7	29.8	
East Fork Ruby River	3.0	WETP	14.0	3.0	1	7.9	24.2	34.3	
Middle Fork Ruby River	5.0	WETP	9.0	5.0	2	11.2	42.5	96.7	
Mill Creek	10.0	WETP	10.0	7.0	3	19.2	28.5	96.0	
North Fork Greenhorn Creek	3.5	WETP	3.5	1.0	4	3.0	7.7	49.9	
Ruby R. #1 above Reservoir	90.0*	WETP	125.0	50.0	2	93.4	177.8	321.3	
Ruby River #2 above mouth	40.0	WETP	40.0	25.0	4	32.1	58	113.8	
Warm Spring Creek	48.5	BF							
West Fork Ruby River	3.0	WETP	6.0	--	2	10.6	14.1	31.2	
Wisconsin Creek	12.0	WETP	12.0	6.0	3	11.5	15.4	47.6	
BEAVERHEAD RIVER DRAINAGE									
Bear Creek	6.5	WETP	6.5	2.5	5	4.8	10.5	15.6	
Beaverhead R. #1 abv Barretts Dam	200.0	WETP	200.0	--	8	255.0	289.0	343.0	
Beaverhead R. #2 above mouth	200.0	WSP	200.0	--	7				
Big Sheep Creek	48.0	WETP	48.0	14.0	1	57.3	72.0	99.6	
Black Canyon Creek	2.5	WETP	2.5	1.5	5	3.6	10.6	17.1	
Blacktail Deer Creek	27.0*	WETP	52.0	32.0	2	77.0	112.0	194.4	
Bloody Dick Creek	20.0	WETP	20.0	--	1	20.0	123.3	209.3	
Browns Canyon Creek	2.3	FP							
Cabin Creek	0.4	WETP	0.4	--	5	0.6	1.1	4.9	
Corral Creek	6.0	WETP	6.0	1.5	1	4.6	11.8		
Deadman Creek	4.5	WETP	4.5	2.5	2	7.4	10.3	14.8	
East Fork Blacktail Deer Creek	18.0	WETP	18.0	12.0	2	19.9	35.6	49.6	
East Fork Clover Creek	4.4	WETP	4.4	1.4	2	4.2	6.9	10.4	
East Fork Dyce Creek	1.4	WETP	1.4	0.4	5	1.3	2.1	4.4	
Frying Pan Creek	1.6	WETP	1.6	1.0	5	2.2	4.8	9.8	
Grasshopper Creek	25.8*	WETP	30.0	--	1	53.9	105.4	234.6	
Hell Roaring Creek	15.0	WETP	15.0	8.0	2	13.5	62.8	110.3	
Horse Prairie Creek	36.0*	WETP	36.0	20.0	2	37.6	127.9	198.0	
Indian Creek	0.2	WETP	0.2	--	4	0.7	1.7	2.6	
Jones Creek	1.9	WETP	1.9	1.1	4	1.7	3.2	7.0	
Long Creek	3.4	WETP	3.4	2.2	2	5.7	10.2	24.6	
Medicine Lodge Creek	10.0	WETP	10.0	--	2	14.5	28.8	59.8	
Narrows Creek									
spawning (5/1-7/15)	1.2	BIOL							
rearing (7/16-4/30)	0.5	BIOL							
Odell Creek	11.0	WETP	11.0	5.0	2	12.8	49.1	72.5	
Peet Creek	0.9	WETP	0.9	0.3	5	1.3	4.3	16.6	
Poindexter Slough	57.9	BF							
Rape Creek	0.4	WETP	0.4	--	4	0.6	1	1.7	
Red Rock Creek	15.0	WETP	15.0	7.0	2	25.8	52.5	89.9	
Red Rock R. #1 above Lima Res.	55.0	FP							
Red Rock R. #2 above Clark Canyon	60.0	WETP	60.0	40.0	5	87.0	259.0	463.0	
Reservoir Creek	1.5	FP							
Shenon Creek	0.4	WETP	0.4	--	4	0.7	1.0	1.7	
Simpson Creek	0.7	WETP	0.7	0.4	3	0.6	1.6	4.7	
Tom Creek	1.4	WETP	1.4	--	1	0.7	3.4	16.6	

Table C-7 (continued)

Stream	Request	Method[a]	Flow (cfs) corresponding to: Upper inflection point	Flow (cfs) corresponding to: Lower inflection point	Number of riffle cross sections	Flow (cfs) measured to determine stage-discharge relationships			
Trapper Creek	0.7	WETP	0.7	--	5	0.9	3.7	12.1	
W.Fork Blacktail Deer Creek	3.0	WETP	3.0	1.0	1	8.9	18.1	36.8	
W.Fork Dyce Creek	0.7	FP							
MISSOURI RIVER DRAINAGE THREE FORKS-HOLTER DAM									
Avalanche Creek	5.0	WETP	5.0	3.0	2	6.2	10.7	13.3	
Beaver Creek (Canyon Ferry tributary)	2.8	WETP	2.8	1.8	5	5.3	12.4	72.6	
Beaver Creek (Holter Lake tributary)	10.0	WETP	10.0	4.0	4	5.7	10.7	21.9	
Confederate Gulch	5.0	WETP	5.0	2.0	4	3.9	22.0	45.6	
Cottonwood Creek	1.0	WETP	1.0	0.6	4	0.3	5.4	12.4	
Crow Creek	11.0	WETP	11.0	6.0	4	21.7	40.0	72.3	
Deep Creek	9.0	FP							
Dry Creek	1.8	WETP	1.8	1.2	3	4.5	6.2	11.6	
Duck Creek	8.0	WETP	8.0	4.0	1	9.6	12.8	34.6	
McGuire Creek									
5/1-11/30 summer base flow	8.3	BIOL							
12/1-4/30 winter base flow	4.7	BIOL							
Missouri R. #1 abv Canyon Ferry	2400.0	WETP	2400.0	--	2	1680.0	4220.0	6470.0	
Missouri R. #2 Hauser to Holter									
10/15-12/15-brown trout spawning	4,878.0								
12/16-3/15-incubation of brn. trout	3,000.0								
3/16-4/30-spawning & incubation	5,316.0								
5/1-6/30-spawning & incubation	7,890.0								
7/1-10/14-riffle maintenance	3,500.0	WSP							
Prickly Pear Creek #1 abv E. Helena	22.0	WETP	22.0	8.0	5	36.2	52.4	105.1	
Prickly Pear Ck. #2 abv Lake Helena	30.0	WETP	30.0	14.0	3	23.6	27.9	32.3	50.0
Sevenmile Creek	1.0	WETP	1.0	--	5	1.5	2.6	4.5	
Silver Creek -below Irrigation Canal									
5/1-11/30	13.0	BF							
12/1-4/30	5.4	BF							
Sixteen Mile Creek	20.0	WETP	20.0	12.0	5	20.9	44.4	96.9	
Spokane Creek below Irrigation Canal									
5/1-11/30	4.0	BF							
12/1-4/30	3.0	BF							
Tenmile Creek	12.0	WETP	12.0	4.0	5	4.7	14.5	34.5	
Trout Creek- below Vigilante Camp.	15.0	BF							
Willow Creek	3.5	WETP	3.5	--	3	1.4	5.1	13.0	
MISSOURI RIVER DRAINAGE - HOLTER DAM TO BELT CREEK									
Canyon Creek	10.0	WETP	10.0	5.5	3	5.4	8.3	12.8	
Little Prickly Pear #1 above Clark Creek	22.0	WETP	22.0	12.0	3	32.8	99.2		
Little Prickly Pear #2 above mouth	70.0	WETP	70.0	20.0	5	18.3	33.0	38.0	182.0
Lyons Creek	10.0	WETP	10.0	6.0	5	6.9	16.3	33.0	
Missouri R. #3 Holter to Great Falls									
5/19-7/5 paddlefish migration	6,398.0								
7/6-5/18 side channel habitat	4,100.0								
Sheep Creek	22.0	WETP	22.0	9.0	4	4.9	18.4	53.3	
Stickney Creek									
4/1-4/30 spawning and rearing	7.0								
5/1-5/31 spawning and rearing	34.0								
6/1-6/30 spawning and rearing	35.0								
7/1-7/31 spawning and rearing	7.0								
Virginia Creek	6.0	WETP	11.0	6.0	4	4.3	14.8	48.9	
Wegner Creek									
4/1-4/30 spawning and rearing	8.0								
5/1-5/31 spawning and rearing	41.0								
6/1-6/30 spawning and rearing	38.0								
7/1-7/31 spawning and rearing	8.0								
Wolf Creek	7.0	WETP	7.0	--	5	4.4	7.0	16.4	

Table C-7 (continued)

Stream	Request	Method[a]	Flow (cfs) corresponding to: Upper inflection point	Flow (cfs) corresponding to: Lower inflection point	Number of riffle cross sections	Flow (cfs) measured to determine stage-discharge relationships				
DEARBORN RIVER DRAINAGE										
Bean Lake	2,648.0 af	LAKE								
Dearborn River	110.0	WETP	110.0	50.0	4	24.6	93.2	144.6		
Flat Creek	7.5	WETP	10.0	7.5	3	7.7	33.3			
M.Fork Dearbom River	9.5	WETP	9.5	--	3	13.4	16.6	49.2		
S.Fork Dearbom River	11.5	WETP	11.5	5.5	5	9.7	15.5	42.6		
SMITH RIVER DRAINAGE										
Big Birch Creek	11.0	WETP	11.0	--	5	9.8	16.8	41.1		
Eagle Creek	2.5	WETP	2.5	--	5	1.5	5.2	8.8		
Hound Creek	35.0	WETP	35.0	--	6	21.6	52.2	205.7		
Newlan Creek	3.8	WETP	3.8	2.4	5	2.2	7.2			
N.Fork Deep Creek	1.0	FP								
N.Fork Smith River	9.0	WETP	9.0	--	6	2.4	38.1	106.1		
Rock Creek	11.0	WETP	11.0	--	5	5.6	13.2	34		
Sheep Creek	35.0	WETP	35.0	20.0	6	20.9	59.1	157.4		
Smith River #1 above Sheep Creek	78.5*	WETP	90.0	50.0	8	84.0	186.0	333.0		
Smith River #2 above Hound Creek	150.0	WETP	150.0	80.0	7	142.0	171.0	408.0		
Smith River #3 above mouth	80.0	LOWER INFLECTION POINT FROM REACH 2								
South Fork Smith River	7.0	WETP	7.0	--	5	2.5	10.7	28.2	34.2	
Tenderfoot Creek	15.0	WETP	15.0	9.0	6	10.8	57.7	104.9		
SUN RIVER DRAINAGE										
Elk Creek	16.0	WETP	16.0	--	3	29.0	45.9	171.0		
Ford Creek	12.0	WETP	12.0	6.0	4	11.0	14.6	23.4		
North Fork Willow Creek	3.0	BF								
Sun River #1 above Elk Creek	100.0	WETP	360.0	100.0	6	60.0	107.0	119.0	332.0	502.0
						1355.0	2500.0			
Sun River #2 above mouth	130.0	WETP	220.0	130.0	2	168.0	297.0	561.0		
Willow Creek	3.0	WETP	3.0	--	4	3.1	3.7	12.4		
BELT CREEK DRAINAGE										
Belt Creek #1 above Big Otter Creek	90.0	WETP	90.0	--	2	88.0	211.0	586.0		
Belt Creek #2 above mouth	35.0	WETP	75.0	35.0	5	94.0	152.0	268.0		
Big Otter Creek	5.0	BF								
Dry Fork Belt Creek	7.0	WETP	7.0	--	5	9.1	22.2	29.7		
Logging Creek	6.0	WETP	6.0	3.0	5	5.2	9.3	17.7		
Pilgrim Creek	8.0	WETP	8.0	3.5	5	4.8	12.9	33.5		
Tillinghast Creek	5.5	WETP	5.5	--	5	7.5	19.1	73.5		
MARIAS RIVER DRAINAGE										
Badger Creek	60.0	FP								
Birch Creek	64.0	FP								
Cut Bank Creek	75.0	FP								
Dupuyer Creek	12.0	WETP	12.0	--	4	39.5	67.3	147.6		
Marias River #1 above Tiber Res.	200.0	WETP	200.0	--	7	171.0	464.0	1270.0		
Marias River #2 above Hwy. 223	419.5*	WETP	500.0	--	11	209.0	534.0	1183.0		
Marias River #3 above mouth	488.5*	WETP	560.0	320.0	4	504.0	705.0	1036.0		
North Badger Creek	14.0	WETP	14.0	--	4	18.1	22.1	55.5		
North Fork Dupuyer Creek	12.0	WETP	12.0	8.0	3	13.7	22.3	42.9		
South Badger Creek	40.0	WETP	40.0	12.0	4	34.6	43.7	75.8		
S.Fork Dupuyer Creek	6.0	WETP	6.0	--	3	10.9	16.3	35.8		
S.Fork Two Medicine River	16.0	WETP	16.0	8.0	3	22.3	71.4	200.5		
TETON RIVER DRAINAGE										
Antelope Butte Swamp	460.0 af	LAKE								
Deep Creek	18.0	WETP	18.0	6.0	4	15.0	24.3	27.4	41.7	
McDonald Creek	10.0	BF								

Table C-7 (continued)

Stream	Request	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
N.Fork Deep Creek	7.2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Spring Creek (#2)	4.5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
S.Fork Deep Creek	6.9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Upper Teton River	35.0	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
MISSOURI RIVER DRAINAGE - BELT CREEK TO [redacted]										
Cow Creek	4.5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Highwood Creek	10.0	WETP	10.0	4.0	5	2.9	13.3	30.2		
Missouri R. #4 - G.F. to Marias R. 3/15-5/18 geese nesting 5/19-7/5 paddlefish migration 7/6-8/31 side channel maintence 9/1-3/14 riffles	3,876.0*	WETP	NA	NA	7	4,500	6,400	7,500	10,900	
Missouri R. #5 - Marias to Judith 3/15-5/18 geese nesting 5/19-7/5 paddlefish migration 7/6-8/31 side channel maintence 9/1-3/14 riffles	4,280.0*	A PERCENTAGE OF THE FLOW REQUESTED IN REACH 6								
Missouri R. #6 - Judith to Ft. Peck Reservoir 3/15-5/18 geese nesting 5/19-7/5 paddlefish migration 7/6-8/31 side channel maintence 9/1-3/14 riffles	4,652.0*	WETP	4,700	--	3	5,660	8,200	8,830	13,500	
Shonkin Creek	7.0	WETP	7.0	2.3	5	2.4	6.1	11.6		
JUDITH RIVER DRAINAGE										
Beaver Creek	5.0	WETP	5.0	--	5	6.4	11.4	18.2		
Big Spring Creek #1 - Hatchery to Cottowood Creek	53.5*	WETP	110.0	60.0	6	131.0	217.0	314.0		
Big Spring Creek #2 -Above mouth	100.0	WETP	100.0	--	5	159.0	385.0	564.0		
Cottonwood Creek	4.5	WETP	12.0	4.5	5	5.2	13.2	48.2		
East Fork Big Spring Creek	7.5	WETP	7.5	--	5	5.1	34.4			
Judith River #1 -above Big Spring Ck.	25.0	WETP	25.0	--	3	44.0	114.0	188.0		
Judith River #2 -above mouth	160.0	WETP	300.0	160.0	5	293.0	339.0	619.0		
Lost Fork Judith River	14.0	WETP	14.0	7.0	5	10.3	17.7	45.7		
M.Fork Judith River	22.0	WETP	22.0	--	2	20.8	57.3	158.6		
S.Fork Judith River	3.5	WETP	3.5	--	4	5.0	12.6	34.1		
Warm Spring Creek	110.0	WETP	110.0	--	5	100.1	148.9			
Yogo Creek	3.0	WETP	3.0	--	5	2.4	4.3	9.7		
MUSSELSHELL RIVER DRAINAGE										
Alabaugh Creek	12.0	WETP	12.0	6.0	5	2.8	10.4	21.0		
American Fork Creek	5.5	WETP	5.5	2.5	5	3.1	4.1	65.3		
Big Elk Creek	9.5	WETP	9.5	3.0	4	4.8	13.4	25.0		
Careless Creek	2.0	WETP	2.0	--	5	0.9	1.4	5.4		
Checkerboard Creek	6.0	WETP	6.0	--	4	3.3	7.1	8.9		
Collar Gulch Creek	0.6	FP	--							
Cottonwood Creek	16.0	WETP	16.0	--	5	9.1	31.7	48.8	54.4	106.0
Flatwillow Creek	18.0	WETP	18.0	--	5	15.0	29.0	38.1		
Musselshell R. #1 - above Deadmans Basin Diversion	80.0	WETP method gave an ureasonably high result and professional judgement was used								
Musselshell R. #2 - above Musselshell	80.0	WETP method gave an ureasonably high result and professional judgement was used								

Table C-7 (continued)

Stream	Request	Method[a]	Flow (cfs) corresponding to: Upper inflection point	Flow (cfs) corresponding to: Lower inflection point	Number of riffle cross sections	Flow (cfs) measured to determine stage-discharge relationships			
Musselshell R. #3 - Musselshell to mouth	70.0	WETP	70.0	22.0	5	20.0	118.0	225.0	
N.Fork Musselshell R. #1 - above Bair Reservoir	3.0	WETP	3.0	1.5	5	1.8	5.3	7.1	9.6
N.Fork Musselshell R. #2 - below Bair Reservoir	16.0	WETP	16.0	10.0	5	9.5	24.0	28.6	
Spring Creek	8.0	WETP	8.0	2.5	5	2.8	7.9	13.4	
Swimming Woman Creek	2.0*	WETP	2.5	1.5	5	0.7	1.9	11.3	
S.Fork Musselshell River	30.0	WETP	30.0	12.0	5	8.3	46.6	59.3	
FORT PECK RESERVOIR DRAINAGE AND SMALL TRIBUTARIES									
Big Dry Creek									
3/15-3/31 spawning and rearing	300.0								
4/1-4/30	100.0								
5/1-5/31	35.0								
6/1-10/31	5.5								
Little Dry Creek									
3/15-3/31 spawning and rearing	110.0								
4/1-4/30	42.0								
5/1-5/31	17.0								
6/1-10/31	3.5								

[a] BIOL = determined using a flow vs. biological production or need relationship
WSP = water surface profile
WETP = wetted perimeter
BF = base flow
ALL = all remaining unappropriated flows
FP = fixed percentage
HEBGEN = all flows on streams below Hebgen when reservoir is being filled

* Request reduced to 1/2 average flow as required by law on this gauged stream

Table C-8. Comparison of results from a fixed percentage method to results from DFWP's methods

Stream	Average annual flow (cfs) from USGS (1989)[a]	DFWP request (cfs)	Method used to obtain the requested flow[b]	0.3 times the average annual flow as suggested by Annear and Conder[c]
GALLATIN RIVER DRAINAGE				
Baker Creek	141	14.0	WETP	42.3
Ben Hart Spring Creek	32	29.0	BF	NA
Big Bear Creek	14	2.0	WETP	4.2
Bridger Creek	37	18.3	ALL	11.1
Cache Creek	12	2.6	WETP	3.6
E.Fork Hyalite Creek	14	7.0	WETP	4.2
East Gallatin River #1	92	42.4	ALL	27.6
East Gallatin River #2	120	90.0	WETP	36.0
East Gallatin River #3	320	170.0	WETP	96.0
Gallatin River #1	450	170.0	WETP	135.0
Gallatin River #2	840	400.0	BIO	252.0
Gallatin River #3	1,100	533.5	WETP	330.0
Hell Roaring Creek	50	16.0	FP	15.0
Hyalite Creek #1	66	28.0	WETP	19.8
Hyalite Creek #2	27	16.0	WETP	8.1
M.Fork of W.Fork Gallatin River	22	3.0	WETP	6.6
Porcupine Creek	23	4.5	WETP	6.9
Reese Creek	15	5.0	WETP	4.5
Rocky Creek	32	51.0	ALL	9.6
Sourdough Creek	25	35.9	ALL	7.5
South Cottonwood Creek	33	14.0	WETP	9.9
S.Fork Spanish Creek	46	15.0	WETP	13.8
S.Fork of W.Fork Gallatin River	62	5.0	WETP	18.6
Spanish Creek	82	70.0	WETP	24.6
Squaw Creek	36	12.0	WETP	10.8
Taylor Fork	94	36.0	WETP	28.2
Thompson Spring Creek	32	29.0	BF	NA
W.Fork Gallatin River	110	26.0	WETP	33.0
W.Fork Hyalite Creek	26	12.0	WETP	7.8
MADISON RIVER DRAINAGE				
Antelope Creek	25	14.0	BF	NA
Beaver Creek	79	937.0	HEBGAN	23.7
Black Sand Spring Creek	22	18.7	BF	NA
Blaine Spring Creek	28	23.0	BF	NA
Cabin Creek	58	585.0	HEBGAN	17.4
Cherry Creek	52	15.0	WETP	15.6
Cougar Creek	51	24.0	FP	15.3
Duck Creek	49	23.0	FP	14.7
Elk River	60	28.0	FP	18.0
Grayling Creek	96	34.0	WETP	28.8
Hot Springs Creek	14	5.5	WETP	4.2
Indian Creek	84	48.0	WETP	25.2
Jack Creek	41	28.0	WETP	12.3
Madison R. #1 above Hebgen	510	245*	WETP	153.0
Madison R. #2 above W.Fork	1000	502.5*	WETP	300.0
Madison R. #3 above Ennis	1400	716*	WETP	420.0
Madison R. #4 above mouth	1800	825*	BIOL	540.0
Moore Creek	3	1.4	FP	0.9
North Meadow Creek	18	18.0	WETP	5.4
O'Dell Spring Creek	120	98.0	BF	NA
Red Canyon Creek	6	2.9	FP	1.8
Ruby Creek	9	18.0	WETP	2.7
Squaw Creek	19	14.0	WETP	5.7
Standard Creek	17	10.0	WETP	5.1
S.Fork Madison River	140	92.0	BF	NA
Trapper Creek	7	3.2	FP	2.1
Watkins Creek	11	5.5	FP	3.3
W.Fork Madison River	95	957.0	HEBGEN	28.5
JEFFERSON & BOULDER RIVER DRAINAGES				
Boulder River #1 abv High Ore	100	20.0	WETP	30.0
Boulder River #2 abv Cold Spring	110	24.0	WETP	33.0
Boulder River #3 abv mouth	140	47.0	WETP	42.0
Halfway Creek	5.2	1.9	FP	1.6
Hells Canyon Creek	7	3.6	WETP	2.1
Jefferson River	2300	1095.5*	WETP	690.0
Little Boulder River	21	7.0	WETP	6.3
North Willow Creek	19	7.0	WETP	5.7
South Boulder River	34	12.0	WETP	10.2
South Willow Creek	35	14.0	WETP	10.5
Whitetail Creek	12	3.0	WETP	3.6
Willow Creek	40	14.0	WETP	12.0
Willow Spring Creek	11	9.2	BF	NA
BIG HOLE RIVER DRAINAGE				
American Creek	2	2.8	WETP	0.6
Bear Creek	4	2.8	WETP	1.2
Big Hole R. #1 abv Pintlar Creek	540	160.0	WETP	162.0
Big Hole R. #2 abv old Divide Dam	820	800.0	WETP	246.0
Big Hole R. #3 above mouth	1200	573.0	WETP	360.0
Big Lake Creek	14	4.7	FP	4.2
Birch Creek	28	10.0	WETP	8.4
Bryant Creek	7	1.4	WETP	2.1
California Creek	7	14.0	WETP	2.1
Camp Creek	10	5.0	WSP	3.0
Canyon Creek	20	5.0	WETP	6.0
Corral Creek	2	1.0	WETP	0.6
Deep Creek	70	18.0	WETP	21.0
Delano Creek	0.9	0.3	FP	0.3
Divide Creek	13	3.0	WETP	3.9
Fishtrap Creek	44	10.0	WETP	13.2
Francis Creek	12	4.0	WETP	3.6
French Creek	14	6.0	WETP	4.2
Governor Creek	49	4.0	WETP	14.7
Jacobson Creek	42	14.0	FP	12.6
Jerry Creek	22	7.0	WETP	6.6
Johnson Creek	20	13.0	WETP	6.0
Joseph Creek	12	5.0	WETP	3.6
LaMarche Creek	50	11.0	WETP	15.0
Miner Creek	33	9.0	WETP	9.9
Moose Creek	12	9.0	WETP	3.6
Mussigbrod Creek	29	10.0	WETP	8.7
N.Fork Big Hole River	150	30.0	WETP	45.0
Oregon Creek	1	0.3	WETP	0.3
Pattengail Creek	48	12.0	WETP	14.4
Pintlar Creek	55	10.0	WETP	16.5
Rock Creek	15.7	5.0	FP	4.7
Ruby Creek	24	4.0	WETP	7.2

Table C-8 (continued)

Stream	Average annual flow (cfs) from USGS (1989)[a]	DFWP request (cfs)	Method used to obtain the requested flow[b]	0.3 times the average annual flow as suggested by Annear and Conder[c]
Sevenmile Creek	2	1.8	WETP	0.6
Seymour Creek	28	13.0	WETP	8.4
Sixmile Creek	1	1.6	WETP	0.3
Steel Creek	8	6.0	WETP	2.4
Sullivan Creek	8	4.0	WETP	2.4
Swamp Creek	35	8.0	WETP	10.5
S.Fork Big Hole River	UNK	22.0	WETP	UNK
Tenmile Creek	10	3.8	WETP	3.0
Trail Creek	78	14.0	WETP	23.4
Trapper Creek	14	3.2	WETP	4.2
Twelvemile Creek	7	1.2	WETP	2.1
Warm Springs Creek	32	20.0	WETP	9.6
Willow Creek	18	16.0	WETP	5.4
Wise River	180	35.0	WETP	54.0
Wyman Creek	20	7.0	FP	6.0
RUBY RIVER DRAINAGE				
Coal Creek	7	3.6	FP	2.1
Cottonwood Creek	14	4.0	WETP	4.2
E.Fork Ruby River	10	3.0	WETP	3.0
Mill Creek	31	10.0	WETP	9.3
M.Fork Ruby River	UNK	5.0	WETP	UNK
N.Fork Greenhorn Creek	6	3.5	WETP	1.8
Ruby River #1 above reservoir	180	90.0	WETP	54.0
Ruby River #2 above mouth	210	40.0	WETP	63.0
Warm Springs Creek	64	48.5	BF	NA
Wisconsin Creek	24	12.0	WETP	7.2
W.Fork Ruby River	12	3.0	WETP	3.6
BEAVERHEAD RIVER DRAINAGE				
Bear Creek	9	6.5	WETP	2.7
Beaverhead R. #1 above Barrets Dam	450	200.0	WETP	135.0
Beaverhead R. #2 above mouth	440	200.0	WSP	132.0
Big Sheep Creek	60	48.0	WETP	18.0
Black Canyon Creek	5	2.5	WETP	1.5
Blacktail Deer Creek	55	27.0*	WETP	16.5
Bloody Dick Creek	44	20.0	WETP	13.2
Browns Canyon Creek	5	2.3	FP	1.5
Cabin Creek	1	0.4	WETP	0.3
Corral Creek	2	6.0	WETP	0.6
Deadman Creek	8	4.5	WETP	2.4
E.Fork Blacktail Deer Creek	35	18.0	WETP	10.5
E.Fork Clover Creek	3	4.4	WETP	0.9
E.Fork Dyce Creek	2	1.4	WETP	0.6
Frying Pan Creek	4	1.6	WETP	1.2
Grasshopper Creek	52	25.8*	WETP	15.6
Hell Roaring Creek	22	15.0	WETP	6.6
Horse Prairie Creek	84	36*	WETP	25.2
Indian Creek	1	0.2	WETP	0.3
Jones Creek	2	1.9	WETP	0.6
Long Creek	9	3.4	WETP	2.7
Medicine Lodge Creek	21	10.0	WETP	6.3
Narrows Creek	0.9			0.27
(5/1-7/15)		1.2		
(7/16-4/30)		0.5		
Odell Creek	18	11.0	WETP	5.4
Peet Creek	2	0.9	WETP	0.6
Poindexter Slough	74	57.9	BF	NA
Rape Creek	1	0.4	WETP	0.3
Red Rock Creek	31	15.0	WETP	9.3
Red Rock R. #1 abv Lima Res.	130	55.0	FP	39.0
Red Rock R. #2 abv Clark Canyon	240	60.0	WETP	72.0
Reservoir Creek	3	1.5	FP	0.9
Shenon Creek	1	0.4	WETP	0.3
Simpson Creek	2	0.7	WETP	0.6
Tom Creek	3	1.4	WETP	0.9
Trapper Creek	1	0.7	WETP	0.3
W.Fork Blacktail Deer Creek	13	3.0	WETP	3.9
W.Fork Dyce Creek	1	0.7	FP	0.3
MISSOURI RIVER DRAINAGE - THREE FORKS-HOLTER DAM				
Avalanche Creek	7	5.0	WETP	2.1
Beaver Creek (Canyon Ferry tributary)	16	2.8	WETP	4.8
Beaver Creek (Holter Lake tributary)	12	10.0	WETP	3.6
Confederate Gulch	16	5.0	WETP	4.8
Cottonwood Creek	4	1.0	WETP	1.2
Crow Creek	41	11.0	WETP	12.3
Deep Creek	27	9.0	FP	8.1
Dry Creek	9	1.8	WETP	2.7
Duck Creek	10	8.0	WETP	3.0
McGuire Creek	8			NA
5/1-11/30 summer base flow		8.3		
12/1-4/30 winter base flow		4.7		
Missouri R. #1 abv Canyon Ferry	5183	2400.0	WETP	1,554.9
Missouri R. #2 Hauser to Holter		UNK		UNK
10/15-12/15		4,878		
12/16-3/15		3,000		
3/16-4/30		5,316		
5/1-6/30		7,890		
7/1-10/14		3,500	WSP	
Prickly Pear Creek #1 above E. Helena	46	22.0	WETP	13.8
Prickly Pear Creek #2 above Lake Helena	54	30.0	WETP	16.2
Sevenmile Creek	6	1.0	WETP	1.8
Silver Creek below irrig. canal	14			NA
5/1-11/30		13.0	BF	
12/1-4/30		5.4	BF	
Sixteen Mile Creek	83	20.0	WETP	24.9
Spokane Creek below irrig. canal	9			NA
5/1-11/30		4.0	BF	
12/1-4/30		3.0	BF	
Tenmile Creek	24	12.0	WETP	7.2
Trout Creek below Vigilante Campground	20	15.0	BF	NA
Willow Creek	10	3.5	WETP	3.0
MISSOURI RIVER DRAINAGE - HOLTER DAM TO BELT CREEK				
Canyon Creek	41	10.0	WETP	12.3
Little Prickly Pear #1 above Clark Creek	49	22.0	WETP	14.7
Little Prickly Pear #2 above mouth	120	70.0	WETP	36.0
Lyons Creek	13	10.0	WETP	3.9
Missouri R. #3 Holter to Great Falls	7525			2,257.5
5/19-6/5 paddlefish migration		6,398		
6/6-5/18 side channels		4,100		

Table C-8 (continued)

Stream	Average annual flow (cfs) from USGS (1989)[a]	DFWP request (cfs)	Method used to obtain the requested flow[b]	0.3 times the average annual flow as suggested by Annear and Conder[c]
Sheep Creek	58	22.0	WETP	17.4
Stickney Creek	5			1.5
4/1-4/30 spawning and rearing		7.0		
5/1-5/31 spawning and rearing		34.0		
6/1-6/30 spawning and rearing		35.0		
7/1-7/31 spawning and rearing		7.0		
Virginia Creek	21	6.0	WETP	6.3
Wolf Creek	12	7.0	WETP	3.6
Wegner Creek	7			2.1
4/1-4/30 spawning and rearing		8.0		
5/1-5/31 spawning and rearing		41.0		
6/1-6/30 spawning and rearing		38.0		
7/1-7/31 spawning and rearing		8.0		
DEARBORN RIVER DRAINAGE				
Bean Lake		2,648 af	LAKE	
Dearborn River	200	110.0	WETP	60.0
Flat Creek	34	7.5	WETP	10.2
M.Fork Dearborn River	34	9.5	WETP	10.2
S.Fork Dearborn River	32	11.5	WETP	9.6
SMITH RIVER DRAINAGE				
Big Birch Creek	67	11.0	WETP	20.1
Eagle Creek	13	2.5	WETP	3.9
Hound Creek	73	35.0	WETP	21.9
Newlan Creek	12	3.8	WETP	3.6
N.Fork Deep Creek	4.2	1.0	FP	1.3
N.Fork Smith River	58	9.0	WETP	17.4
Rock Creek	27	11.0	WETP	8.1
Sheep Creek	90	35.0	WETP	27.0
Smith River #1 above Sheep Ck.	170	78.5*	WETP	51.0
Smith River #2 above Hound Ck.	340	150.0	WETP	102.0
Smith River #3 above mouth	UNK	80.0	LOWER INFLECTION POINT FROM REACH 2	UNK
S.Fork Smith River	26	7.0	WETP	7.8
Tenderfoot Creek	6	15.0	WETP	1.8
SUN RIVER DRAINAGE				
Elk Creek	81	16.0	WETP	24.3
Ford Creek	25	12.0	WETP	7.5
N.Fork Willow Creek	5	3.0	BF	1.5
Sun River #1 above Elk Creek	890	100.0	WETP	267.0
Sun River #2 above mouth	450	130.0	WETP	135.0
Willow Creek	8	3.0	WETP	2.4
BELT CREEK DRAINAGE				
Belt Creek #1 abv Big Otter Ck.	170	90.0	WETP	51.0
Belt Creek #2 above mouth	210	35.0	WETP	63.0
Big Otter Creek	11	5.0	BF	NA
Dry Fork Belt Creek	33	7.0	WETP	9.9
Logging Creek	15	6.0	WETP	4.5
Pilgram Creek	25	8.0	WETP	7.5
Tillinghast Creek	18	5.5	WETP	5.4

Stream	Average annual flow (cfs) from USGS (1989)[a]	DFWP request (cfs)	Method used to obtain the requested flow[b]	0.3 times the average annual flow as suggestec by Annear and Conder[c]
MARIAS RIVER DRAINAGE				
Badger Creek	144	60.0	FP	43.2
Birch Creek	120	64.0	FP	36.0
Cut Bank Creek	180	75.0	FP	54.0
Dupuyer Creek	34	12.0	WETP	10.2
Marias River #1 abv Tiber Res.	1010	200.0	WETP	303.0
Marias River #2 abv Hwy. 223	UNK	419.5*	WETP	UNK
Marias River #3 above mouth	880	488.5*	WETP	264.0
North Badger Creek	53	14.0	WETP	15.9
N.Fork Dupuyer Creek	14	12.0	WETP	4.2
South Badger Creek	59	40.0	WETP	17.7
S.Fork Dupuyer Creek	11	6.0	WETP	3.3
S.Fork Two Medicine River	71	16.0	WETP	21.3
TETON RIVER DRAINAGE				
Antelope Butte Swamp		460.0 af	LAKE	
Deep Creek	16	18.0	WETP	4.8
McDonald Creek	12	10.0	BF	NA
N.Fork Deep Creek	18	7.2	FP	5.4
Spring Creek #2	4.7	4.5	BF	NA
S.Fork Deep Creek	17	6.9	FP	5.1
Upper Teton River	150	35.0	WETP	45.0
MISSOURI RIVER DRAINAGE - BELT CREEK TO FORT PECK RESERVOIR				
Cow Creek	9	4.5	WETP	2.7
Highwood Creek	22	10.0	WETP	6.6
Missouri R. #4 - Great Falls to Marias River	7692			2,307.6
3/15-5/18 goose nesting				
5/19-7/5 paddlefish migration				
7/6-8/31 side channel maint.				
9/1-3/14 riffle maintenance		3,876*		
Missouri R. #5 - Marias to Judith	8750			2,625.0
3/15-5/18 goose nesting				
5/19-7/5 paddlefish nesting				
7/6-8/31 side channel maint.				
9/1-3/14 riffle maintenance		4,280*		
Missouri R. #6 - Judith to Ft.Peck Reservoir	9742			2,922.6
3/15-5/18 goose nesting				
5/19-7/5 paddlefish migration				
7/6-8/31 side channels				
9/1-3/14 riffle maintenance		4,652*		
Shonkin Creek	18	7.0	WETP	5.4
JUDITH RIVER DRAINAGE				
Beaver Creek	22	5.0	WETP	6.6
Big Spring Creek #1 - hatchery to Cottonwood Creek	170	53.5	WETP	51.0
Big Spring Creek #2 - abv mouth	230	100.0	WETP	69.0
Cottonwood Creek	19	4.5	WETP	5.7
E.Fork Big Spring Creek	26	7.5	WETP	7.8
Judith River #1 above Big Spring Creek	49	25.0	WETP	14.7
Judith River #2 above mouth	480	160.0	WETP	144.0

Table C-8 (continued)

Stream	Average annual flow (cfs) from USGS (1989)[a]	DFWP request (cfs)	Method used to obtain the requested flow[b]	0.3 times the average annual flow as suggested by Annear and Conder[c]
Lost Fork Judith River	24	14.0	WETP	7.2
M.Fork Judith River	42	22.0	WETP	12.6
S.Fork Judith River	10	3.5	WETP	3.0
Warm Spring Creek	110	110.0	WETP method did not work well and professional judgment used	33.0
Yogo Creek	8	3.0	WETP	2.4
MUSSELSHELL RIVER DRAINAGE				
Alabaugh Creek	12	12.0	WETP	3.6
American Fork Creek	7	5.5	WETP	2.1
Big Elk Creek	15	9.5	WETP	4.5
Careless Creek	5	2.0	WETP	1.5
Checkerboard Creek	6	6.0	WETP	1.8
Collar Gulch Creek	1.4	0.7	FP	0.4
Cottonwood Creek	53	16.0	WETP	15.9
Flatwillow Creek	41	18.0	WETP	12.3
Musselshell R. #1 above Deadmans Basin Diversion	160	80.0	WETP method gave an ureasonably high result and professional judgment was used	48.0

Stream	Average annual flow (cfs) from USGS (1989)[a]	DFWP request (cfs)	Method used to obtain the requested flow[b]	0.3 times the average annual flow as suggested by Annear and Conder[c]
Musselshell R. #2 above Musselshell	210	80.0	WETP method gave an ureasonably high result and professional judgment was used	63.9
Musselshell R. #3 Musselshell to mouth	310	70.0	WETP	93.0
N.Fork Musselshell R. #1 above Bair Res.	12	3.0	WETP	3.6
N.Fork Musselshell R. #2 below Bair Res.	23	5.0	WETP	6.9
Spring Creek	19	8.0	WETP	5.7
Swimming Woman Creek	4	5.0	WETP	1.2
S.Fork Musselshell River	88	30.0	WETP	26.4
FORT PECK RESERVOIR DRAINAGE AND SMALL TRIBUTARIES				
Big Dry Creek	56			16.8
3/15-3/31 spawning & rearing		300.0		
4/1-4/30		100.0		
5/1-5/31		35.0		
6/1-10/31		5.5		
Little Dry Creek	23			6.9
3/15-3/31 spawning & rearing		110.0		
4/1-4/30		42.0		
5/1-5/31		17.0		
6/1-10/31		3.5		

[a] Estimates of depleted flows, not natural flows.

[b] UNK = unknown
BIO = determined using a flow vs. biological production relationship
WSP = water surface profile
WETP = wetted perimeter
BF = base flow
ALL = all remaining unappropriated flows
FP = fixed percentage
HEBGEN = all flows on streams below Hebgen when reservoir is being filled

[c] NA = not applicable
UNK = unknown

* Request reduced to 1/2 average flow as required by law on this gauged stream.

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APPROXIMATE WATER EQUIVALENTS

1 cubic foot = 7.48 gallons

1 acre-foot (af) = 43,560 cubic feet, or 325,851 gallons
An acre-foot covers one acre of land one foot deep.

1 cubic foot per second (cfs) = 448.8 gallons per minute

1 cfs = 40 Montana statutory miner's inches

1 cfs = 646,316 gallons per day
for 24 hours = 1.98 acre-feet
for 30 days = 59.5 acre-feet
for 1 year = 725 acre-feet

1 million gallons = 3.07 acre-feet

1 million gallons per day (mgd) = 1,122 acre-feet per year

1,000 gallons per minute (gpm) = 2.23 cfs

1,000 gpm = 4.42 acre-feet per day

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